

Table 9.1-1
Period-of-Record Index by Sample Location, Surface Water Program, Mine Study Area

| Sample Location | Year | Period-of-Record By Discipline | | | | | | | | | | | | Streams sampled 2005 | Streams Sampled 2009 | | | | | | | | | | | | | | | | |
|-----------------|-------|--------------------------------|---|----|---|---|---|-----------------------|---|---|---|---|---|----------------------|----------------------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|--|--|
| | | Surface Hydrology | | | | | | Surface Water Quality | | | | | | | | | | | | | | | | | | | | | | | |
| | | J | F | M | A | M | J | J | A | S | O | N | D | J | F | M | A | M | J | J | A | S | O | N | D | | | | | | |
| KC100A | Month | | | | | | | | | | | | | | | | | | | | | | | | | 1 | 1 | | | | |
| | 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2005 | I | I | C | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2006 | I | I | C | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2007 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2008 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2009 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KR100A | 2012 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | 1 | | | | |
| | 2005 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2006 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2007 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2008 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2009 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2010 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2011 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| KR127B | 2012 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| KR127C | 2012 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2004 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| NK100A (USGS) | 2012 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | 1 | 1 | | | |
| | 2005 | I | I | C | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2006 | I | I | C | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2007 | C | C | C | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2008 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2009 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2010 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2011 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2012 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| NK100A1 | 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2007 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2008 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2009 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2010 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2011 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2012 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| NK100B | 2005 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | 1 | 1 | | |
| | 2006 | I | I | I | I | I | I | I | I | I | I | I | I | | | | | | | | | | | | | | | | | | |
| | 2007 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2008 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2009 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2010 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2011 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| | 2012 | I | I | I | C | C | C | C | C | C | C | C | C | | | | | | | | | | | | | | | | | | |
| NK100B1 | 2005 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| | 2009 | | | </ | | | | | | | | | | | | | | | | | | | | | | | | | | | |

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|---------------|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| NK100C | 2005 | I | I | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2006 | I | I | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2007 | I | I | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2008 | I | I | I | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2009 | I | I | I | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2010 | I | I | I | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2011 | I | I | I | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q |
| | 2012 | I | I | I | I | C | C | C | C | Q | Q | Q | Q | Q | Q | Q |
| NK100C1 | 2005 | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | |
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| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | | | |
| NK119A | 2004 | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| NK119B | 2012 | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | |
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| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| SK100A | 2012 | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | |
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| | 2007 | | | | | | | | | | | | | | | |
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| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| SK100B (USGS) | 2012 | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| SK100B1 | 2012 | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | |
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| | 2009 | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| SK100B2 | 2012 | | | | | | | | | | | | | | | |
| | 2005 | | | | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | | | |

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|--------|------|---|---|---|---|---|---|---|---|---|---|---|---|
| SK100D | 2005 | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2006 | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2007 | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2008 | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2009 | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | |
| | 2005 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2006 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2007 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| SK100F | 2008 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2009 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2010 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2011 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2012 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| SK100G | 2005 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2006 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2007 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2008 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2009 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2010 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2011 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2012 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| SK116A | 2005 | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | Q | Q | Q | Q | Q |
| | 2010 | | | | | | | | Q | Q | Q | Q | Q |
| | 2011 | | | | | | | | Q | Q | Q | Q | Q |
| | 2012 | | | | | | | | Q | Q | Q | Q | Q |
| SK117A | 2005 | | | | | | | | | | | | |
| | 2006 | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | |
| | 2009 | | | | | | | | Q | Q | Q | Q | Q |
| | 2010 | | | | | | | | Q | Q | Q | Q | Q |
| | 2011 | | | | | | | | Q | Q | Q | Q | Q |
| | 2012 | | | | | | | | Q | Q | Q | Q | Q |
| SK119A | 2005 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2006 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2007 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2008 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2009 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2010 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2011 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| | 2012 | I | I | C | C | C | C | C | Q | Q | Q | Q | Q |
| SK134A | 2005 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2006 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2007 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2008 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2009 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2010 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2011 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2012 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| UT100A | 2005 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2006 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2007 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2008 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2009 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2010 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |
| | 2011 | I | I | I | I | I | I | I | Q | Q | Q | Q | Q |

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|-----------|------|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 2005 | I | I | C | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 2006 | I | I | C | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 2007 | I | I | I | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 2008 | I | I | I | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 2009 | I | I | I | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 2010 | I | I | I | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | |
| | 2011 | | | | | | | | | | | | | | | | | | | | | | |
| UT100E | 2005 | | | | | | | | | | | | | | | | | | | | | | 1 |
| UT106APC1 | 2005 | | | | | | | | | | | | | | | | | | | | | | 1 |
| UT119A | 2005 | I | I | C | C | C | C | C | C | C | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | 1 |
| UT119B | 2005 | I | I | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | 1 |
| UT135A | 2005 | I | I | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | 1 |
| UT138A | 2005 | I | I | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | 1 |
| UT141A | 2005 | I | I | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | 1 |
| UT146A | 2005 | I | I | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | Q | 1 |
| Seeps | 2005 | | | | | | | | | | | | | | | | | | | | | | 1 |
| | 2006 | | | | | | | | | | | | | | | | | | | | | | |
| | 2007 | | | | | | | | | | | | | | | | | | | | | | |
| | 2008 | | | | | | | | | | | | | | | | | | | | | | |
| | 2009 | | | | | | | | | | | | | | | | | | | | | | |
| | 2010 | | | | | | | | | | | | | | | | | | | | | | |
| | 2011 | | | | | | | | | | | | | | | | | | | | | | |

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| UT135A | 2005 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2006 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2007 | I | I | C | C | C | C | C | I | I | Q | Q | Q | Q | Q |
| | 2008 | I | I | I | C | C | C | C | I | I | Q | Q | Q | Q | Q |
| | 2009 | I | I | I | C | C | C | C | I | I | | | | | |
| | 2010 | I | I | I | C | C | C | C | I | I | | | | | |
| | 2011 | | | | | | | | | | | | | | |
| | 2012 | | | | | | | | | | | | | | |
| | 2005 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2006 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| UT146A | 2007 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2008 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2009 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2010 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2011 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |
| | 2012 | I | I | I | I | I | I | I | I | Q | Q | Q | Q | Q | Q |

Key:

- C** Continuous stage/discharge hydrometric data collected in streams (gaged streams with data loggers).
- I** Instantaneous stream discharge measurements taken each month coincident with water quality (ungaged stations without data loggers).
- Q** Surface water quality samples collected for field and laboratory analysis.

31 34

Table 9.1-2**Pebble Project 2004 - 2012 Summary of Laboratory Analyses for Stream Surface Water and Seeps**

| Parameter | Method | Streams (NFK, SFK, MUT, KC) ^a | Streams (KR127, MAPC) and Seeps ^b |
|----------------------|--------------------------|--|--|
| <i>Inorganics</i> | | | |
| | | <i>April 2009 - December 2012</i> | <i>2005 - 2012</i> |
| pH | SM4500H+ B | X | X |
| Specific Conductance | SM2510B | | X |
| Acidity | SM2310B | | X |
| Alkalinity | SM2320B | X | X |
| Ammonia as N | SM4500NH ₃ -G | X | X |
| Chloride | E300.0 | | X |
| Cyanide, total | SM4500-CN C,E | | X |
| Cyanide, WAD | SM4500-CN I | X | X |
| Cyanide, speciation | ASTM D6994-04M | | X |
| Fluoride | E300.0 | | X |
| Hardness | SM2340B | X | X |
| Nitrate + Nitrite | SM4500-NO ₃ F | | X |
| Phosphorus, total | SM4500P-B,E | | X |
| Sulfate | E300.0 | | X |
| Thiocyanate | SM4500CN-M | | X |
| TDS | SM2540C | X | X |
| TSS | SM2540D | X | X |
| Low-level Mercury | E1631E | X | X |
| Metals | E200.7/E200.8 | X | X |
| <i>Organics</i> | | | |
| DRO | AK102 | X | |
| RRO | AK103 | X | |
| GRO | AK101 | X | |
| BTEX | SW8260 | X | |
| DOC/TOC | SM5310B | X | X |

Notes:

a. Total and dissolved metals for NFK, SFK, MUT, and KC streams: Al, Sb, Ba, Cd, Co, Cu, Fe, Pb, Mn, Ni, Zn, and Hardness.

b. Total and dissolved metals for groundwater and KR (trib 1.270), MAPC, and NH streams: Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Cr, Co, Cu,

c. Total metals for snow: Al, Sb, As, Ba, Be, Bi, B, Cd, Ca, Cr, Co, Cu, Fe, Pb, Mg, Mn, Mo, Ni, K, Se, Ag, Na, Tl, Sn, V, Zn.

d. Organics analysis performed only at 4 SFK, 2 NFK, and 3 MUT sites.

MUT Locations: UT00B, UT100C, UT100D, UT100E, UT119A, UT146A

MAPC Locations: UT100APC1, UT100APC2, UT100APC3, UT106APC1

Table 9.1-3
Surface Water Data Summary for Naturally Occurring Constituents
North Fork Koktuli

| Sample Period | Analyte ^a | Frequency of Detection | Percent Detected | Range of Detects (Min-Max) | Range of Reporting Limits (MRL) | Range of Detection Limits (MDL) (Min-Max) | Mean ^c | Median ^c | Standard Deviation ^c | Coefficient of Variation |
|---|--------------------------------------|------------------------|------------------|----------------------------|---------------------------------|---|-------------------|---------------------|---------------------------------|--------------------------|
| Field and Physical Parameters (mg/L, except where noted) | | | | | | | | | | |
| | Total Dissolved Solids | 323 / 327 | 99% | 3.10 - 72.5 | 10 - 10.3 | 3.10 - 3.20 | 36.6 | 37.5 | 11.7 | 0.32 |
| | pH (Field, Standard Units) | 348 / 348 | 100% | 3.31 - 8.36 | NA - NA | NA - NA | 6.65 | 6.70 | 0.68 | 0.10 |
| | Dissolved Oxygen | 342 / 342 | 100% | 5.75 - 14.6 | NA - NA | NA - NA | 9.89 | 9.94 | 1.87 | 0.19 |
| | Water Temperature (°C) | 347 / 347 | 100% | -0.30 - 19 | NA - NA | NA - NA | 4.17 | 1.27 | 4.79 | 1.15 |
| | Specific Conductivity (Field, uS/cm) | 345 / 345 | 100% | 7.0 - 710 | NA - NA | NA - NA | 47.9 | 47 | 38.4 | 0.80 |
| | Turbidity (NTU) | 319 / 319 | 100% | 0.10 - 8.8 | NA - NA | NA - NA | 1.04 | 0.74 | 1.14 | 1.09 |
| | Total Suspended Solids | 263 / 325 | 81% | 0.15 - 10.8 | 0.48 - 2.08 | 0.14 - 0.63 | 1.19 | 0.79 | 1.39 | 1.16 |
| | ORP (mv) | 343 / 343 | 100% | -248 - 349 | NA - NA | NA - NA | 137 | 155 | 95.1 | 0.69 |
| Major Ions (mg/L) | | | | | | | | | | |
| Discontinued Apr 2009 | Calcium - dissolved | 230 / 230 | 100% | 1.82 - 10.1 | 0.050 - 0.25 | 0.015 - 0.075 | 5.16 | 5.32 | 1.63 | 0.37 |
| Discontinued Apr 2009 | Calcium - total | 235 / 235 | 100% | 1.79 - 9.88 | 0.050 - 0.25 | 0.015 - 0.079 | 5.12 | 5.24 | 1.62 | 0.32 |
| Discontinued Apr 2009 | Magnesium - dissolved | 231 / 231 | 100% | 0.38 - 2.66 | 0.0050 - 0.18 | 0.0016 - 0.058 | 1.33 | 1.36 | 0.55 | 0.32 |
| Discontinued Apr 2009 | Magnesium - total | 235 / 235 | 100% | 0.37 - 2.86 | 0.0050 - 0.22 | 0.0016 - 0.071 | 1.32 | 1.35 | 0.56 | 0.26 |
| Discontinued Apr 2009 | Sodium - dissolved | 231 / 231 | 100% | 0.99 - 3.41 | 0.070 - 0.25 | 0.022 - 0.078 | 2.41 | 2.48 | 0.51 | 0.45 |
| Discontinued Apr 2009 | Sodium - total | 235 / 235 | 100% | 1.18 - 3.58 | 0.10 - 0.19 | 0.031 - 0.061 | 2.39 | 2.46 | 0.52 | 0.34 |
| Discontinued Apr 2009 | Potassium - dissolved | 226 / 226 | 100% | 0.096 - 1.15 | 0.0040 - 0.13 | 0.0014 - 0.038 | 0.41 | 0.42 | 0.16 | 0.41 |
| Discontinued Apr 2009 | Potassium - total | 236 / 236 | 100% | 0.081 - 1.10 | 0.0040 - 0.080 | 0.0014 - 0.029 | 0.40 | 0.41 | 0.16 | 0.43 |
| Discontinued Apr 2009 | Alkalinity, Total | 334 / 336 | 99% | 3.10 - 49.1 | 10 - 20 | 3.10 - 6.20 | 21.4 | 22.3 | 7.83 | 0.40 |
| Discontinued Apr 2009 | Sulfate | 234 / 234 | 100% | 0.53 - 9.56 | 0.10 - 0.10 | 0.031 - 0.031 | 2.21 | 2.09 | 1.13 | 0.21 |
| Discontinued Apr 2009 | Chloride | 237 / 237 | 100% | 0.20 - 1.38 | 0.10 - 0.10 | 0.031 - 0.031 | 0.65 | 0.63 | 0.17 | 0.22 |
| Discontinued Apr 2009 | Fluoride | 122 / 237 | 52% | 0.031 - 0.14 | 0.10 - 0.10 | 0.031 - 0.031 | 0.039 | 0.031 | 0.018 | |
| | Hardness as CaCO ₃ | 327 / 327 | 100% | 5.90 - 36.4 | 0.50 - 1.53 | 0.16 - 1.0 | 18.1 | 18.3 | 6.22 | 0.51 |
| Nutrients, (mg/L) | | | | | | | | | | |
| Discontinued Apr 2009 | Total Ammonia - N | 53 / 291 | 18% | 0.031 - 0.17 | 0.10 - 0.20 | 0.031 - 0.062 | 0.050 | 0.031 | 0.032 | 0.64 |
| Discontinued Apr 2009 | Nitrate-Nitrite | 176 / 229 | 77% | 0.031 - 3.94 | 0.10 - 2 | 0.031 - 2 | 0.19 | 0.10 | 0.35 | 1.82 |
| Discontinued Apr 2009 | Total Phosphorous | 192 / 233 | 82% | 0.0031 - 0.17 | 0.0070 - 0.10 | 0.0022 - 0.031 | 0.023 | 0.018 | 0.018 | 0.78 |
| | Total Orthophosphate (as P) | 0 / 40 | 0% | 0.031 - 0.10 | 0.10 - 0.10 | 0.031 - 0.031 | 0.079 | 0.10 | 0.032 | 0.40 |
| Total Metals (mg/L) | | | | | | | | | | |
| Discontinued Apr 2009 | Aluminum - total | 313 / 325 | 96% | 0.0036 - 0.42 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.034 | 0.022 | 0.043 | 1.27 |
| Discontinued Apr 2009 | Arsenic - total | 77 / 236 | 33% | 0.000099 - 0.00079 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.00034 | 0.00031 | 0.000098 | 0.29 |
| Discontinued Apr 2009 | Barium - total | 287 / 287 | 100% | 0.0013 - 0.013 | 0.000050 - 0.00030 | 0.000025 - 0.000094 | 0.0034 | 0.0033 | 0.0013 | 0.37 |
| Discontinued Apr 2009 | Cadmium - total | 29 / 323 | 9% | 0.0000062 - 0.000094 | 0.000020 - 0.00010 | 0.0000062 - 0.000037 | 0.000020 | 0.000015 | 0.0000097 | 0.49 |
| Discontinued Apr 2009 | Chromium - total | 179 / 234 | 77% | 0.000062 - 0.0010 | 0.00020 - 0.00020 | 0.000062 - 0.00010 | 0.00029 | 0.00025 | 0.00016 | 0.55 |
| Discontinued Apr 2009 | Copper - total | 236 / 324 | 73% | 0.00015 - 0.0036 | 0.000060 - 0.0012 | 0.000021 - 0.00042 | 0.00042 | 0.00039 | 0.00025 | 0.61 |
| Discontinued Apr 2009 | Iron - total | 326 / 326 | 100% | 0.015 - 1.05 | 0.0080 - 0.020 | 0.0027 - 0.0062 | 0.22 | 0.21 | 0.16 | 0.72 |
| Discontinued Apr 2009 | Lead - total | 86 / 324 | 27% | 0.000022 - 0.0024 | 0.000050 - 0.00020 | 0.000022 - 0.00010 | 0.00012 | 0.000032 | 0.000028 | 2.27 |
| Discontinued Apr 2009 | Manganese - total | 322 / 323 | 100% | 0.00088 - 0.096 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.013 | 0.011 | 0.012 | 0.95 |
| Discontinued Apr 2009 | Molybdenum - total | 207 / 235 | 88% | 0.000015 - 0.00055 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00018 | 0.00017 | 0.000094 | 0.52 |
| Discontinued Apr 2009 | Nickel - total | 207 / 308 | 67% | 0.000030 - 0.00093 | 0.000090 - 0.00062 | 0.000030 - 0.000062 | 0.00025 | 0.00020 | 0.00014 | 0.57 |
| Discontinued Apr 2009 | Selenium - total | 8 / 154 | 5% | 0.000029 - 0.00031 | 0.000090 - 0.0010 | 0.000029 - 0.00031 | 0.00027 | 0.00031 | 0.000082 | 0.31 |
| Discontinued Apr 2009 | Silver - total | 5 / 232 | 2% | 0.0000029 - 0.000020 | 0.000010 - 0.000020 | 0.0000029 - 0.000062 | 0.0000064 | 0.0000062 | 0.0000020 | 0.31 |
| Discontinued Apr 2009 | Zinc - total | 170 / 324 | 53% | 0.00044 - 0.015 | 0.00050 - 0.0031 | 0.00026 - 0.00047 | 0.0023 | 0.0020 | 0.0016 | 0.68 |

| Dissolved Metals (mg/L) | | | | | | | | | | |
|----------------------------------|--------------------------------|-----------|------|----------------------|---------------------|----------------------|-----------|-----------|-----------|------|
| Discontinued Apr 2009 | Aluminum - dissolved | 299 / 325 | 92% | 0.002 - 0.063 | 0.00020 - 0.063 | 0.000070 - 0.020 | 0.013 | 0.0089 | 0.011 | 0.82 |
| | Arsenic - dissolved | 54 / 233 | 23% | 0.000081 - 0.00067 | 0.000040 - 0.0013 | 0.000012 - 0.00063 | 0.00031 | 0.00031 | 0.000071 | 0.23 |
| | Barium - dissolved | 254 / 254 | 100% | 0.0014 - 0.0072 | 0.000050 - 0.00075 | 0.000025 - 0.00024 | 0.0031 | 0.0031 | 0.00084 | 0.27 |
| Discontinued Apr 2009 | Cadmium - dissolved | 23 / 325 | 7% | 0.0000062 - 0.000078 | 0.000020 - 0.00025 | 0.0000062 - 0.000078 | 0.000020 | 0.000015 | 0.000010 | 0.50 |
| | Chromium - dissolved | 150 / 216 | 69% | 0.000062 - 0.00094 | 0.000020 - 0.00050 | 0.000062 - 0.00025 | 0.00028 | 0.00024 | 0.00014 | 0.52 |
| | Copper - dissolved | 163 / 237 | 69% | 0.00016 - 0.0017 | 0.000060 - 0.00050 | 0.000021 - 0.00016 | 0.00041 | 0.00041 | 0.00015 | 0.37 |
| | Iron - dissolved | 316 / 326 | 97% | 0.0062 - 0.44 | 0.0080 - 0.050 | 0.0027 - 0.016 | 0.11 | 0.093 | 0.071 | 0.67 |
| | Lead - dissolved | 58 / 285 | 20% | 0.000022 - 0.00037 | 0.000050 - 0.00050 | 0.000022 - 0.00025 | 0.000070 | 0.000036 | 0.000055 | 0.79 |
| | Manganese - dissolved | 314 / 314 | 100% | 0.00048 - 0.054 | 0.000040 - 0.0025 | 0.000013 - 0.0013 | 0.0082 | 0.0068 | 0.0067 | 0.81 |
| Discontinued Apr 2009 | Molybdenum - dissolved | 182 / 210 | 87% | 0.0000062 - 0.00078 | 0.000020 - 0.0025 | 0.0000062 - 0.00078 | 0.00019 | 0.00018 | 0.00011 | 0.55 |
| | Nickel - dissolved | 142 / 184 | 77% | 0.000077 - 0.0012 | 0.000090 - 0.00062 | 0.000030 - 0.00016 | 0.00033 | 0.00029 | 0.00016 | 0.48 |
| Discontinued Apr 2009 | Selenium - dissolved | 13 / 236 | 6% | 0.000029 - 0.00078 | 0.000090 - 0.0025 | 0.000029 - 0.00078 | 0.00028 | 0.00031 | 0.000077 | 0.27 |
| Discontinued Apr 2009 | Silver - dissolved | 6 / 236 | 3% | 0.0000029 - 0.000016 | 0.000010 - 0.000050 | 0.0000029 - 0.000016 | 0.0000062 | 0.0000062 | 0.0000097 | 0.16 |
| | Zinc - dissolved | 140 / 230 | 61% | 0.00068 - 0.0075 | 0.00050 - 0.0038 | 0.00026 - 0.0012 | 0.0025 | 0.0022 | 0.0012 | 0.49 |
| Cyanides (mg/L) | | | | | | | | | | |
| Discontinued Apr 2009 | Cyanide, Total | 15 / 210 | 7% | 0.0015 - 0.0050 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0020 | 0.0015 | 0.00082 | 0.40 |
| | Cyanide, Weak Acid Dissociable | 32 / 327 | 10% | 0.0015 - 0.012 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0024 | 0.0015 | 0.0014 | 0.59 |
| Organic Compounds, (mg/L) | | | | | | | | | | |
| | Dissolved Organic Carbon | 200 / 201 | 100% | 0.17 - 4.83 | 0.5 - 0.5 | 0.15 - 0.15 | 1.58 | 1.39 | 0.88 | 0.56 |

Notes:

^a Beginning April 2009 the analyte list was reduced to field parameters, alkalinity, ammonia, cyanide (WAD), Hardness, TDS, TSS, mercury, aluminum, barium, cadmium, copper, iron, lead, manganese, nickel and zinc.

^b Frequency of detection (FOD) = Number of detected samples / total number of samples in data set.

^c When calculating the average, median, and standard deviation, non-detects with "U" or "UJ" qualifiers were included as the value of the RDL. Non-detect results of zero, without "U" or "UJ" qualifiers, were included as the value of the RDL.

Key:

NA = Not applicable.

°C = degrees Celsius.

MDL = method detection limit.

MRL = method reporting limit.

mg/L = milligram per liter.

uS/cm = microSiemens per centimeter.

mV = millivolt.

NTU = nephelometric turbidity units.

ORP = oxidation reduction potential.

Table 9.1-4
Comparison of Human Health and Freshwater Aquatic Life Water Quality Criteria with Naturally Occurring Constituents in Surface Water
North Fork Koktuli River

| Analyte | Number of Samples | Chronic Aquatic Life Criteria | Number of Samples Exceeding Criteria ^a Drinking Water Standards |
|---|-------------------|-------------------------------|---|
| Field and Physical Parameters (mg/L, except where noted) | | | |
| Total Dissolved Solids | 329 | -- | 0 |
| pH (Field) | 348 | 130 | 51 |
| Dissolved Oxygen (Field) | 342 | 1 | 0 |
| Major Ions (mg/L) | | | |
| Alkalinity | 336 | 115 | -- |
| Sulfate | 237 | -- | 0 |
| Chloride | 237 | 0 | 0 |
| Fluoride | 237 | -- | 0 |
| Nutrients (mg/L) | | | |
| Ammonia | 291 | 0 | -- |
| Nitrate + Nitrite | 231 | -- | 0 |
| Total Metals (mg/L) | | | |
| Aluminum | 328 | 21 | -- |
| Arsenic | 236 | -- | 0 |
| Barium | 287 | -- | 0 |
| Cadmium | 328 | 8 | 0 |
| Chromium | 236 | 0 | 0 |
| Copper | 328 | 7 | 0 |
| Iron | 328 | 3 | 93 |
| Lead | 328 | 35 | 0 |
| Manganese | 328 | -- | 9 |
| Mercury | 325 | 0 | 0 |
| Nickel | 328 | 0 | 0 |
| Selenium | 236 | 0 | 0 |
| Silver | 236 | 1 | -- |
| Zinc | 328 | 2 | -- |
| Dissolved Metals (mg/L) | | | |
| Aluminum | 325 | 0 | -- |
| Arsenic | 234 | -- | 0 |
| Barium | 255 | -- | 0 |
| Cadmium | 328 | 6 | 0 |
| Chromium | 216 | 0 | 0 |
| Copper | 240 | 4 | 0 |
| Iron | 326 | 0 | 3 |
| Lead | 288 | 15 | 0 |
| Manganese | 317 | -- | 0 |
| Nickel | 219 | 0 | -- |
| Selenium | 236 | 0 | 0 |
| Silver | 236 | 0 | -- |

Zinc

232

0

--

| Cyanides (mg/L) | | | |
|-----------------|-----|---|---|
| Cyanide WAD | 328 | 7 | 0 |

Notes:

^a Surface water sample results were compared to criteria from ADEC (2008 and 2009). Drinking water standards were compared to total metals data. Chronic aquatic life criteria were compared to both total and dissolved metals data. Hardness-dependent criteria are based on preliminary estimates.

Key:

-- = Not applicable.

mg/L = milligrams per liter

WAD = weak acid dissociable

References:

Alaska Department of Environmental Conservation (ADEC). 2008. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. As amended through December 12, 2008.

ADEC. 2009. 18 AAC 70. Water Quality Standards. Amended as of September 19, 2009.

Table 9.1-5**Upstream to Downstream Sample Location Ranks for Spatial Analyses****North Fork Koktuli River**

| Location ^a | Rank ^b |
|-----------------------|-------------------|
| NK100C | 1 |
| NK100B | 2 |
| NK100A1 | 3 |
| NK100A | 4 |

Notes:

NK100B1 and NK100C1 were sampled Oct 2012 for field water quality parameters only.

^a Only main stem sample locations were included in the upstream to downstream ranking and analyses.

^b Ranks begin with most upstream location (1= most upstream, 6 = most downstream).

Table 9.1-6
Results of Spatial Regression Analysis of Results for Naturally Occurring Constituents in Surface Water
North Fork Koktuli River

| Analyte | tau | p-Value | S | D | VarS | Spatial Trend | ts.interce pt | ts.slope | R ² Value | Regression Significantly Different? ^a |
|---|----------|------------|--------|-------|---------|---------------|---------------|----------|----------------------|--|
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | | | |
| Total Dissolved Solids | -0.194 | 0.0000862 | -4610 | 23700 | 1380000 | Decreasing | 46.3 | -1.67 | 0.037636 | YES |
| pH (Field, Standard Units) | -0.013 | 0.786 | -344 | 26500 | 1600000 | Stable | 6.72 | 0.01 | 0.000169 | NO |
| Dissolved Oxygen | 0.117 | 0.0152 | 2960 | 25300 | 1490000 | Increasing | 9.06 | 0.18 | 0.013689 | YES |
| Water Temperature (°C) | 0.00615 | 0.899 | 161 | 26200 | 1580000 | Stable | 0.01 | 0.0238 | 0.0000378 | NO |
| Specific Conductivity (Field, uS/cm) | -0.304 | 3.57E-10 | -7830 | 25800 | 1560000 | Decreasing | 63.8 | -3 | 0.092416 | YES |
| Turbidity (NTU) | -0.276 | 2.54E-08 | -6340 | 23000 | 1290000 | Decreasing | 1.28 | -0.132 | 0.076176 | YES |
| Total Suspended Solids | -0.233 | 0.00000224 | -5450 | 23300 | 1330000 | Decreasing | 1.45 | -0.144 | 0.054289 | YES |
| ORP (mV) | 0.0517 | 0.281 | 1340 | 25900 | 1540000 | Stable | 137 | 4.25 | 0.00267289 | NO |
| Major Ions (mg/L) | | | | | | | | | | |
| Calcium - total | -0.378 | 1.11E-10 | -4440 | 11800 | 475000 | Decreasing | 7480 | -389 | 0.142884 | YES |
| Magnesium - total | -0.44 | 6.34E-14 | -5170 | 11700 | 475000 | Decreasing | 2230 | -157 | 0.1936 | YES |
| Sodium - total | 0.0262 | 0.656 | 308 | 11700 | 475000 | Stable | 2460 | 45 | 0.00068644 | NO |
| Potassium - total | -0.456 | 7.22E-15 | -5360 | 11800 | 475000 | Decreasing | 568 | -30.6 | 0.207936 | YES |
| Alkalinity, Total | -0.368 | 3.31E-14 | -9240 | 25100 | 1490000 | Decreasing | 30.8 | -1.6 | 0.135424 | YES |
| Sulfate | 0.0625 | 0.288 | 726 | 11600 | 466000 | Stable | 1.94 | 0.0775 | 0.00390625 | NO |
| Chloride | 0.141 | 0.0157 | 1680 | 11900 | 483000 | Increasing | 0.525 | 0.0266 | 0.019881 | YES |
| Fluoride | -0.0668 | 0.293 | -684 | 10200 | 421000 | Stable | 0.032 | 0 | 0.00446224 | NO |
| Hardness as CaCO ₃ | -0.398 | 4.29E-16 | -9550 | 24000 | 1380000 | Decreasing | 27.9 | -1.8 | 0.158404 | YES |
| Nutrients, (mg/L) | | | | | | | | | | |
| Nitrogen, Nitrate-Nitrite | 0.000892 | 0.989 | 10 | 11200 | 448000 | Stable | 0.099 | 0 | 7.96E-07 | NO |
| Total Metals (mg/L) | | | | | | | | | | |
| Aluminum | -0.0594 | 0.227 | -1400 | 23600 | 1340000 | Stable | 23.9 | -1.1 | 0.00352836 | NO |
| Arsenic | -0.426 | 1.43E-11 | -4380 | 10300 | 421000 | Decreasing | 0.31 | 0 | 0.181476 | YES |
| Barium | 0.0522 | 0.322 | 935 | 17900 | 891000 | Stable | 3.21 | 0.0308 | 0.00272484 | NO |
| Chromium | -0.166 | 0.00505 | -1910 | 11500 | 465000 | Decreasing | 0.349 | -0.0243 | 0.027556 | YES |
| Copper | 0.0286 | 0.573 | 644 | 22500 | 1300000 | Stable | 0.373 | 0 | 0.00081796 | NO |
| Iron | -0.519 | 0 | -12400 | 23800 | 1360000 | Decreasing | 485 | -63.1 | 0.269361 | YES |
| Manganese | -0.255 | 2.33E-07 | -5920 | 23200 | 1310000 | Decreasing | 20.6 | -2.19 | 0.065025 | YES |
| Molybdenum | 0.362 | 0 | 4190 | 11600 | 466000 | Increasing | 0.044 | 0.0292 | 0.131044 | YES |
| Nickel | -0.307 | 2.87E-09 | -6140 | 20000 | 1070000 | Decreasing | 0.251 | -0.009 | 0.094249 | YES |
| Zinc | -0.0509 | 0.319 | -1140 | 22400 | 1300000 | Stable | 2.5 | -0.03 | 0.00259081 | NO |

^aDifferences are considered statistically significant if the p-value is less than 0.050.

Linear regression analysis was conducted using results from each main stem sample location.

Decreasing - analyte concentration is decreasing with downstream distance.

Increasing - analyte concentration is increasing with downstream distance.

Stable - analyte concentration is stable with downstream distance.

Table 9.1-7
Surface Water Data Summary for Naturally Occurring Constituents
South Fork Koktuli

| Analyte | of Detection | Percent Detected | Range of Detects (Min-Max) | Limits (MRL) | Limits (MDL) | Mean ^b | Median ^b | Standard Deviation ^b | Coefficient of Variation |
|---|--------------|------------------|----------------------------|---------------------|----------------------|-------------------|---------------------|---------------------------------|--------------------------|
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | | |
| Total Dissolved Solids | 490 / 493 | 99% | 3.1 - 96.2 | 10 - 13.3 | 3.1 - 4.13 | 39.4 | 36.2 | 17.8 | 0.45 |
| pH (Field, Standard Units) | 603 / 603 | 100% | 3.54 - 8.85 | NA - NA | NA - NA | 6.63 | 6.65 | 0.60 | 0.09 |
| Dissolved Oxygen | 597 / 597 | 100% | 3.53 - 18.2 | NA - NA | NA - NA | 9.89 | 9.88 | 2.03 | 0.20 |
| Water Temperature (°C) | 607 / 607 | 100% | -0.33 - 23.4 | NA - NA | NA - NA | 4.33 | 2.03 | 4.71 | 1.1 |
| Specific Conductivity (Field, uS/cm) | 600 / 600 | 100% | 20 - 133 | NA - NA | NA - NA | 52.3 | 45 | 22.2 | 0.42 |
| Turbidity (NTU) | 484 / 484 | 100% | 0.080 - 23 | NA - NA | NA - NA | 1.34 | 0.78 | 1.98 | 1.5 |
| Total Suspended Solids | 439 / 492 | 89% | 0.15 - 16 | 0.49 - 5 | 0.15 - 1.5 | 1.69 | 1.03 | 1.98 | 1.2 |
| ORP (mV) | 587 / 587 | 100% | -259 - 516 | NA - NA | NA - NA | 128 | 138 | 92.5 | 0.72 |
| Major Ions (mg/L) | | | | | | | | | |
| Calcium - dissolved | 330 / 330 | 100% | 2.28 - 13.4 | 0.050 - 1.04 | 0.015 - 0.33 | 6.18 | 5.44 | 2.36 | 0.38 |
| Calcium - total | 333 / 333 | 100% | 2.34 - 13.8 | 0.050 - 2 | 0.015 - 0.60 | 6.17 | 5.38 | 2.29 | 0.37 |
| Magnesium - dissolved | 329 / 329 | 100% | 0.35 - 3.9 | 0.0050 - 0.19 | 0.0016 - 0.063 | 1.4 | 1.09 | 0.79 | 0.56 |
| Magnesium - total | 333 / 333 | 100% | 0.28 - 3.9 | 0.0050 - 0.21 | 0.0016 - 0.067 | 1.4 | 1.09 | 0.78 | 0.56 |
| Sodium - dissolved | 330 / 330 | 100% | 1.09 - 4.67 | 0.070 - 0.20 | 0.022 - 0.062 | 2.33 | 2.09 | 0.76 | 0.33 |
| Sodium - total | 333 / 333 | 100% | 1.1 - 5.23 | 0.10 - 0.20 | 0.031 - 0.062 | 2.32 | 2.05 | 0.75 | 0.32 |
| Potassium - dissolved | 326 / 326 | 100% | 0.12 - 1.07 | 0.0040 - 0.10 | 0.0014 - 0.030 | 0.36 | 0.32 | 0.14 | 0.40 |
| Potassium - total | 333 / 333 | 100% | 0.11 - 0.96 | 0.0040 - 0.10 | 0.0014 - 0.030 | 0.35 | 0.31 | 0.14 | 0.40 |
| Alkalinity, Total | 496 / 500 | 99% | 3.1 - 40 | 10 - 20 | 3.1 - 6.2 | 18 | 16 | 7.54 | 0.42 |
| Sulfate | 333 / 333 | 100% | 0.90 - 28.8 | 0.10 - 0.50 | 0.031 - 0.16 | 8 | 5.34 | 6.09 | 0.76 |
| Chloride | 333 / 333 | 100% | 0.14 - 1.45 | 0.10 - 0.50 | 0.031 - 0.16 | 0.69 | 0.70 | 0.18 | 0.25 |
| Fluoride | 206 / 334 | 62% | 0.031 - 0.23 | 0.10 - 0.50 | 0.031 - 0.16 | 0.044 | 0.036 | 0.022 | 0.50 |
| Hardness as CaCO ₃ | 493 / 493 | 100% | 7.91 - 52.9 | 0.50 - 4 | 0.17 - 4 | 20.5 | 17.4 | 9.03 | 0.44 |
| Nutrients, (mg/L) | | | | | | | | | |
| Total Ammonia - N | 74 / 423 | 18% | 0.031 - 0.16 | 0.10 - 0.10 | 0.031 - 0.031 | 0.052600 | 0.031 | 0.032 | 0.61 |
| Nitrate-Nitrite | 274 / 322 | 85% | 0.031 - 1.21 | 0.10 - 2 | 0.031 - 0.62 | 0.17 | 0.13 | 0.15 | 0.90 |
| Total Phosphorous | 258 / 330 | 78% | 0.0031 - 0.095 | 0.0070 - 0.10 | 0.0022 - 0.031 | 0.019 | 0.014 | 0.016 | 0.83 |
| Total Orthophosphate (as P) | 0 / 68 | 0% | 0.031 - 0.10 | 0.10 - 0.10 | 0.031 - 0.031 | 0.070 | 0.10 | 0.035 | 0.50 |
| Total Metals (mg/L) | | | | | | | | | |
| Aluminum - total | 483 / 491 | 98% | 0.0019 - 1.09 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.039 | 0.025 | 0.061 | 1.6 |
| Arsenic - total | 82 / 330 | 25% | 0.00016 - 0.0010 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.00033 | 0.00031 | 0.000097 | 0.30 |
| Barium - total | 417 / 417 | 100% | 0.0013 - 0.016 | 0.000050 - 0.0010 | 0.000025 - 0.00010 | 0.0041 | 0.0032 | 0.0023 | 0.56 |
| Cadmium - total | 45 / 487 | 9% | 0.0000062 - 0.000073 | 0.000020 - 0.00010 | 0.0000062 - 0.000037 | 0.000019 | 0.000015 | 0.0000083 | 0.44 |
| Chromium - total | 223 / 333 | 67% | 0.000062 - 0.0011 | 0.000020 - 0.00040 | 0.000062 - 0.00020 | 0.00027 | 0.00023 | 0.00017 | 0.62 |
| Copper - total | 437 / 473 | 92% | 0.00011 - 0.0090 | 0.000060 - 0.0020 | 0.000021 - 0.00020 | 0.0014 | 0.0010 | 0.0013 | 0.90 |
| Iron - total | 475 / 493 | 96% | 0.0062 - 2.41 | 0.0080 - 0.080 | 0.0027 - 0.025 | 0.29 | 0.15 | 0.30 | 1 |
| Lead - total | 127 / 488 | 26% | 0.000022 - 0.0030 | 0.000050 - 0.00020 | 0.000022 - 0.00010 | 0.00011 | 0.000048 | 0.00024 | 2.2 |
| Manganese - total | 493 / 493 | 100% | 0.00011 - 0.20 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.024 | 0.011 | 0.028 | 1.2 |
| Molybdenum - total | 323 / 331 | 98% | 0.000015 - 0.0017 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00051 | 0.00042 | 0.00028 | 0.55 |
| Nickel - total | 323 / 477 | 68% | 0.000062 - 0.0013 | 0.000090 - 0.0025 | 0.000030 - 0.00025 | 0.00033 | 0.00025 | 0.00019 | 0.58 |
| Selenium - total | 35 / 260 | 14% | 0.000058 - 0.00062 | 0.000090 - 0.0020 | 0.000029 - 0.00062 | 0.00029 | 0.00031 | 0.000073 | 0.25 |
| Silver - total | 18 / 327 | 6% | 0.000003 - 0.000031 | 0.000010 - 0.000020 | 0.0000029 - 0.000062 | 0.000064 | 0.000062 | 0.000020 | 0.32 |
| Zinc - total | 295 / 491 | 60% | 0.00031 - 0.022 | 0.00050 - 0.012 | 0.00026 - 0.0012 | 0.0027 | 0.0028 | 0.0021 | 0.76 |

| Dissolved Metals (mg/L) | | | | | | | | | | |
|----------------------------------|-----------|------|----------------------|---------------------|----------------------|----------|----------|-----------|------|--|
| Aluminum - dissolved | 445 / 464 | 96% | 0.0020 - 0.040 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.0098 | 0.0080 | 0.0069 | 0.71 | |
| Arsenic - dissolved | 59 / 329 | 18% | 0.00012 - 0.00091 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.00031 | 0.00031 | 0.000064 | 0.20 | |
| Barium - dissolved | 388 / 388 | 100% | 0.0010 - 0.0096 | 0.000050 - 0.00030 | 0.000025 - 0.000094 | 0.0039 | 0.0031 | 0.0021 | 0.53 | |
| Cadmium - dissolved | 29 / 485 | 6% | 0.0000062 - 0.000074 | 0.000020 - 0.00010 | 0.0000062 - 0.000074 | 0.000019 | 0.000015 | 0.0000081 | 0.43 | |
| Chromium - dissolved | 200 / 306 | 65% | 0.000062 - 0.0010 | 0.00020 - 0.00040 | 0.000062 - 0.00020 | 0.00025 | 0.00021 | 0.00015 | 0.58 | |
| Copper - dissolved | 371 / 418 | 89% | 0.00015 - 0.0049 | 0.000060 - 0.00050 | 0.000021 - 0.000062 | 0.0011 | 0.00088 | 0.00075 | 0.69 | |
| Iron - dissolved | 442 / 488 | 91% | 0.0062 - 1 | 0.0080 - 0.040 | 0.0027 - 0.012 | 0.12 | 0.062 | 0.13 | 1.1 | |
| Lead - dissolved | 82 / 427 | 19% | 0.000022 - 0.00042 | 0.000050 - 0.00020 | 0.000022 - 0.00010 | 0.000072 | 0.000033 | 0.000062 | 0.86 | |
| Manganese - dissolved | 474 / 474 | 100% | 0.000056 - 0.12 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.019 | 0.0078 | 0.024 | 1.3 | |
| Molybdenum - dissolved | 306 / 313 | 98% | 0.000031 - 0.0017 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00051 | 0.00042 | 0.00028 | 0.55 | |
| Nickel - dissolved | 210 / 292 | 72% | 0.000090 - 0.0012 | 0.000090 - 0.00062 | 0.000030 - 0.00012 | 0.00042 | 0.00039 | 0.00020 | 0.48 | |
| Selenium - dissolved | 34 / 334 | 10% | 0.000047 - 0.00062 | 0.000090 - 0.0020 | 0.000029 - 0.00062 | 0.00029 | 0.00031 | 0.000067 | 0.23 | |
| Silver - dissolved | 7 / 333 | 2% | 0.000003 - 0.000013 | 0.000010 - 0.000020 | 0.0000029 - 0.000062 | 0.000062 | 0.000062 | 0.000008 | 0.13 | |
| Zinc - dissolved | 243 / 366 | 66% | 0.00047 - 0.011 | 0.00050 - 0.0031 | 0.00026 - 0.00047 | 0.0028 | 0.0031 | 0.0013 | 0.46 | |
| Cyanides (mg/L) | | | | | | | | | | |
| Cyanide | 25 / 330 | 8% | 0.0015 - 0.016 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0024 | 0.0015 | 0.0015 | 0.63 | |
| Cyanide, Weak Acid Dissociable | 37 / 469 | 8% | 0.0015 - 0.0078 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0022 | 0.0015 | 0.0012 | 0.54 | |
| Organic Compounds, (mg/L) | | | | | | | | | | |
| Dissolved Organic Carbon | 272 / 305 | 89% | 0.15 - 4.76 | 0.50 - 0.50 | 0.15 - 0.15 | 1.27 | 1.02 | 0.88 | 0.69 | |

Notes:

^a Frequency of detection (FOD) = Number of detected samples / total number of samples in data set.

^b When calculating the average, median, and standard deviation, non-detects with "U" or "UJ" qualifiers were included as the value of the RDL. Non-detect results of zero, without "U" or "UJ" qualifiers, were included as the value of the RDL.

Key:

NA = Not applicable

°C = degrees Celsius

MDL = method detection limit

MRL = method reporting limit

mg/L = milligram per liter

uS/cm = microSiemens per centimeter

mV = millivolt

NTU = nephelometric turbidity units

ORP = oxidation reduction potential

Table 9.1-8
Comparison of Human Health and Freshwater Aquatic Life Water Quality Criteria with Naturally Occurring Constituents in Surface Water
South Fork Koktuli River

| Analyte | Number of Samples | Number of Samples Exceeding Criteria ^a | |
|---|-------------------|---|--------------------------|
| | | Chronic Aquatic Life Criteria | Drinking Water Standards |
| Field and Physical Parameters (mg/L, except where noted) | | | |
| Total Dissolved Solids | 502 | -- | 0 |
| pH (Field) | 617 | 243 | 82 |
| Dissolved Oxygen (Field) | 611 | 6 | 15 |
| Major Ions (mg/L) | | | |
| Alkalinity | 510 | 327 | -- |
| Chloride | 342 | 0 | 0 |
| Fluoride | 342 | -- | 0 |
| Sulfate | 342 | -- | 0 |
| Nutrients (mg/L) | | | |
| Ammonia | 436 | 0 | -- |
| Nitrate + Nitrite | 334 | -- | 0 |
| Total Metals (mg/L) | | | |
| Aluminum | 503 | 47 | -- |
| Arsenic | 342 | -- | 0 |
| Barium | 428 | -- | 0 |
| Cadmium | 503 | 13 | 0 |
| Chromium | 342 | 0 | 0 |
| Copper | 503 | 103 | 0 |
| Iron | 503 | 19 | 189 |
| Lead | 503 | 37 | 0 |
| Manganese | 503 | -- | 70 |
| Mercury | 496 | 8 | 8 |
| Nickel | 503 | 0 | 0 |
| Selenium | 342 | 0 | 0 |
| Silver | 342 | 8 | -- |
| Zinc | 503 | 0 | -- |
| Dissolved Metals (mg/L) | | | |
| Aluminum | 492 | 0 | -- |
| Arsenic | 339 | -- | 0 |
| Barium | 397 | -- | 0 |
| Cadmium | 501 | 12 | 0 |
| Chromium | 314 | 0 | 0 |
| Copper | 426 | 56 | 0 |
| Iron | 496 | 0 | 0 |
| Lead | 435 | 11 | 0 |
| Manganese | 483 | -- | 0 |
| Nickel | 350 | 0 | 0 |
| Selenium | 342 | 0 | 0 |
| Silver | 341 | 8 | -- |

Zinc

378

0

--

| Cyanides (mg/L) | | | |
|-----------------|-----|----|---|
| Cyanide WAD | 502 | 12 | 8 |

Notes:

^a Surface water sample results were compared to criteria from ADEC (2008 and 2009). Drinking water standards were compared to total metals data. Chronic aquatic life criteria were compared to both total and dissolved metals data. Hardness-dependent criteria are based on preliminary estimates.

mg/L = milligrams per liter

WAD = weak acid dissociable

Key:

-- = Not applicable.

References:

Alaska Department of Environmental Conservation (ADEC). 2008. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. As amended through December 12, 2008.

ADEC. 2009. 18 AAC 70. Water Quality Standards. Amended as of September 19, 2009.

Table 9.1-9
Upstream to Downstream Sample Location Ranks for Spatial Analyses
South Fork Koktuli River

| Location ^a | Rank ^b |
|-------------------------|-------------------|
| SK100G | 1 |
| SK100F | 2 |
| SK100B2 | 3 |
| SK100B1 | 4 |
| SK100LF9 ^c | 5 |
| SK100B | 6 |
| SK100LF9.6 ^c | 7 |
| SK100LF10 ^c | 8 |
| SK100LF11 ^c | 9 |
| SK100A | 10 |

Notes:

^a Only main stem sample locations were included in the upstream to downstream ranking and analyses.

^b Ranks begin with most upstream location (1= most upstream, 10= most downstream).

^c Samples were only tested for field parameters from 2009 - 2012.

Table 9.1-10
Results of Spatial Regression Analysis of Results for Naturally Occurring Constituents in Surface Water
South Fork Koktuli River

| Analyte | tau | p-Value | S D VarS | Spatial Trend | ts.interce pt | ts.slope | R ² Value | Regression Significantly Different? ^a |
|---|---------|-------------|----------|---------------|------------------|----------|----------------------|---|
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | |
| Total Dissolved Solids | -0.257 | 1.05E-11 | | Decreasing | | | 0.066049 | YES |
| pH (Field, Standard Units) | -0.067 | 0.0523 | | Stable | | | 0.004489 | No |
| Dissolved Oxygen | 0.182 | 0.000000119 | | Increasing | | | 0.033124 | YES |
| Water Temperature (°C) | -0.0338 | 0.325 | | Stable | | | 0.00114244 | No |
| Specific Conductivity (Field, uS/cm) | -0.268 | 1.39E-14 | | Decreasing | | | 0.071824 | YES |
| Turbidity (NTU) | -0.406 | 0 | | Decreasing | | | 0.164836 | YES |
| Total Suspended Solids | -0.194 | 2.13E-07 | | Decreasing | | | 0.037636 | YES |
| ORP (mV) | 0.164 | 2.62E-06 | | Increasing | | | 0.026896 | YES |
| Major Ions (mg/L) | | | | | | | | |
| Calcium - total | -0.308 | 2.06E-12 | | Decreasing | | | 0.094864 | YES |
| Magnesium - total | -0.367 | 6.44E-17 | | Decreasing | | | 0.134689 | YES |
| Sodium - total | -0.312 | 1.39E-12 | | Decreasing | | | 0.097344 | YES |
| Potassium - total | -0.285 | 8.51E-11 | | Decreasing | | | 0.081225 | YES |
| Alkalinity, Total | -0.0246 | 0.508 | | Stable | | | 0.00060516 | No |
| Sulfate | -0.556 | 0 | | Decreasing | | | 0.309136 | YES |
| Chloride | 0.157 | 0.000358 | | Increasing | | | 0.024649 | YES |
| Fluoride | -0.271 | 6.43E-09 | | Decreasing | | | 0.073441 | YES |
| Hardness as CaCO ₃ | -0.296 | 2.81E-15 | | Decreasing | | | 0.087616 | YES |
| Nutrients, (mg/L) | | | | | | | | |
| Nitrogen, Nitrate-Nitrite | -0.0383 | 0.393 | | Stable | | | 0.00146689 | No |
| Total Metals (mg/L) | | | | | | | | |
| Aluminum | -0.194 | 2.12E-07 | | Decreasing | | | 0.037636 | YES |
| Arsenic | -0.16 | 0.0012 | | Decreasing | | | 0.0256 | YES |
| Barium | -0.685 | 0 | | Decreasing | | | 0.469225 | YES |
| Chromium | -0.0613 | 0.169 | | Stable | | | 0.00375769 | No |
| Copper | -0.614 | 0 | | Decreasing | | | 0.376996 | YES |
| Iron | -0.604 | 0 | | Decreasing | | | 0.364816 | YES |
| Manganese | -0.624 | 0 | | Decreasing | | | 0.389376 | YES |
| Molybdenum | -0.558 | 0 | | Decreasing | | | 0.311364 | YES |
| Nickel | -0.418 | 0 | | Decreasing | | | 0.174724 | YES |
| Zinc | -0.185 | 1.32E-06 | | Decreasing | | | 0.034225 | YES |

^a Differences are considered statistically significant if the p-value is less than 0.050.

Linear regression analysis was conducted using results from each main stem sample location.

Decreasing - analyte concentration is decreasing with downstream distance.

Increasing - analyte concentration is increasing with downstream distance.

Stable - analyte concentration is stable with downstream distance.

Table 9.1-11
Surface Water Data Summary for Naturally Occurring Constituents
Upper Talarik Creek

| Analyte | Frequency | | Range of Detects (Min-Max) | Range of Reporting | | Range of Detection | | Mean ^b | Median ^b | Standard Deviation ^b | Coefficient of Variation |
|---|--------------|------------------|-------------------------------|---------------------|----------------------|--------------------|---------------------|-------------------|---------------------|---------------------------------|--------------------------|
| | of Detection | Percent Detected | | Limits (MRL) | Limits (MDL) | Mean ^b | Median ^b | | | | |
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | | | | |
| Total Dissolved Solids | 588 / 590 | 100% | 3.75 - 115 | 5 - 10 | 3.1 - 10 | 52.8 | 49 | 19.1 | 0.36 | | |
| pH (Field, Standard Units) | 764 / 764 | 100% | 4.5 - 9.33 | NA - NA | NA - NA | 6.9 | 6.92 | 0.54 | 0.078 | | |
| Dissolved Oxygen | 757 / 757 | 100% | 2.69 - 18.6 | NA - NA | NA - NA | 9.7 | 9.53 | 1.83 | 0.19 | | |
| Water Temperature (°C) | 767 / 767 | 100% | -0.93 - 15.7 | NA - NA | NA - NA | 3.89 | 2.96 | 3.82 | 0.98 | | |
| Specific Conductivity (Field, uS/cm) | 760 / 760 | 100% | 10 - 750 | NA - NA | NA - NA | 77.6 | 73 | 38.3 | 0.49 | | |
| Turbidity (NTU) | 570 / 570 | 100% | 0.0 - 16.3 | NA - NA | NA - NA | 1.39 | 0.87 | 1.71 | 1.2 | | |
| Total Suspended Solids | 470 / 584 | 81% | 0.15 - 25.8 | 0.49 - 5 | 0.15 - 5 | 3.21 | 1.83 | 3.62 | 1.10 | | |
| ORP (mV) | 729 / 729 | 100% | -180 - 519 | NA - NA | NA - NA | 115 | 112 | 72.6 | 0.63 | | |
| Major Ions (mg/L) | | | | | | | | | | | |
| Calcium - dissolved | 443 / 443 | 100% | 2.37 - 17.3 | 0.050 - 0.96 | 0.0060 - 0.31 | 8.92 | 8.9 | 2.38 | 0.27 | | |
| Calcium - total | 445 / 445 | 100% | 2.12 - 16.7 | 0.050 - 2 | 0.0060 - 0.60 | 8.95 | 8.97 | 2.33 | 0.26 | | |
| Magnesium - dissolved | 442 / 442 | 100% | 0.64 - 4.73 | 0.0050 - 0.20 | 0.00030 - 0.062 | 2.1 | 1.7 | 0.98 | 0.47 | | |
| Magnesium - total | 444 / 444 | 100% | 0.66 - 5 | 0.0050 - 0.22 | 0.00030 - 0.071 | 2.1 | 1.7 | 0.97 | 0.46 | | |
| Sodium - dissolved | 443 / 443 | 100% | 1.02 - 6.73 | 0.070 - 0.25 | 0.020 - 0.078 | 2.77 | 2.55 | 0.74 | 0.27 | | |
| Sodium - total | 444 / 444 | 100% | 0.95 - 6.84 | 0.10 - 0.50 | 0.020 - 0.16 | 2.77 | 2.53 | 0.73 | 0.26 | | |
| Potassium - dissolved | 435 / 435 | 100% | 0.11 - 1.2 | 0.0040 - 2 | 0.0014 - 0.060 | 0.45 | 0.40 | 0.18 | 0.40 | | |
| Potassium - total | 443 / 443 | 100% | 0.19 - 1.36 | 0.0040 - 2 | 0.0014 - 0.060 | 0.45 | 0.39 | 0.18 | 0.40 | | |
| Alkalinity, Total | 600 / 601 | 100% | 3.73 - 74 | 2 - 20 | 0.80 - 6.2 | 31.6 | 31.8 | 9.4 | 0.30 | | |
| Sulfate | 444 / 444 | 100% | 0.90 - 41.6 | 0.10 - 2 | 0.012 - 0.18 | 6.28 | 3.3 | 8.14 | 1.3 | | |
| Chloride | 442 / 443 | 100% | 0.031 - 1.15 | 0.10 - 0.40 | 0.016 - 0.060 | 0.70 | 0.70 | 0.14 | 0.20 | | |
| Fluoride | 350 / 429 | 82% | 0.0060 - 0.16 | 0.10 - 0.40 | 0.0050 - 0.060 | 0.044 | 0.037 | 0.021 | 0.49 | | |
| Hardness as CaCO ₃ | 591 / 591 | 100% | 7.25 - 62.2 | 0.40 - 20 | 0.10 - 20 | 32 | 30.8 | 9.49 | 0.30 | | |
| Nutrients, (mg/L) | | | | | | | | | | | |
| Total Ammonia - N | 99 / 526 | 19% | 0.0050 - 0.25 | 0.050 - 0.10 | 0.0050 - 0.031 | 0.042 | 0.031 | 0.034 | 0.81 | | |
| Nitrate-Nitrite | 405 / 435 | 93% | 0.0050 - 1.74 | 0.050 - 2 | 0.0040 - 0.62 | 0.21 | 0.17 | 0.20 | 0.94 | | |
| Total Phosphorous | 364 / 442 | 82% | 0.0031 - 0.11 | 0.0070 - 0.10 | 0.0020 - 0.031 | 0.019 | 0.014 | 0.016 | 0.83 | | |
| Total Orthophosphate (as P) | 0 / 47 | 0% | 0.031 - 0.10 | 0.10 - 0.10 | 0.031 - 0.031 | 0.068 | 0.10 | 0.035 | 0.51 | | |
| Total Metals (mg/L) | | | | | | | | | | | |
| Aluminum - total | 573 / 584 | 98% | 0.0032 - 0.66 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.073 | 0.037 | 0.096 | 1.3 | | |
| Arsenic - total | 310 / 445 | 70% | 0.00012 - 0.0028 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.00095 | 0.00090 | 0.00066 | 0.69 | | |
| Barium - total | 528 / 528 | 100% | 0.0012 - 0.018 | 0.000050 - 0.00030 | 0.0000090 - 0.000094 | 0.0053 | 0.0050 | 0.0024 | 0.45 | | |
| Cadmium - total | 84 / 578 | 15% | 0.0000030 - 0.00010 | 0.000020 - 0.00010 | 0.0000030 - 0.000037 | 0.000017 | 0.000015 | 0.000010 | 0.60 | | |
| Chromium - total | 375 / 445 | 84% | 0.000062 - 0.0012 | 0.00020 - 0.00020 | 0.000020 - 0.00010 | 0.00036 | 0.00030 | 0.00019 | 0.54 | | |
| Copper - total | 430 / 590 | 73% | 0.000050 - 0.0054 | 0.000060 - 0.00050 | 0.000020 - 0.00062 | 0.00061 | 0.00040 | 0.00076 | 1.2 | | |
| Iron - total | 586 / 588 | 100% | 0.015 - 1.3 | 0.0080 - 0.10 | 0.00080 - 0.031 | 0.24 | 0.16 | 0.21 | 0.88 | | |
| Lead - total | 221 / 586 | 38% | 0.000050 - 0.0028 | 0.000020 - 0.00020 | 0.0000030 - 0.00010 | 0.000089 | 0.000053 | 0.00015 | 1.7 | | |
| Manganese - total | 587 / 587 | 100% | 0.00068 - 0.16 | 0.000040 - 0.0010 | 0.0000060 - 0.00050 | 0.026 | 0.013 | 0.030 | 1.2 | | |
| Molybdenum - total | 400 / 427 | 94% | 0.000015 - 0.00053 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00025 | 0.00027 | 0.000094 | 0.38 | | |
| Nickel - total | 430 / 575 | 75% | 0.000030 - 0.0040 | 0.000090 - 0.00062 | 0.000020 - 0.00090 | 0.00061 | 0.00040 | 0.00063 | 1 | | |
| Selenium - total | 12 / 441 | 3% | 0.000030 - 0.00040 | 0.000090 - 0.0010 | 0.000029 - 0.00040 | 0.00030 | 0.00031 | 0.000066 | 0.22 | | |
| Silver - total | 50 / 438 | 11% | 0.0000029 - 0.000032 | 0.000010 - 0.000020 | 0.0000029 - 0.000090 | 0.0000076 | 0.0000062 | 0.0000047 | 0.62 | | |
| Zinc - total | 295 / 588 | 50% | 0.00020 - 0.016 | 0.00050 - 0.0031 | 0.000050 - 0.00047 | 0.0025 | 0.0023 | 0.0016 | 0.66 | | |

| Dissolved Metals (mg/L) | | | | | | | | | | |
|----------------------------------|-----------|------|----------------------|---------------------|----------------------|-----------|-----------|-----------|------|--|
| Aluminum - dissolved | 550 / 564 | 98% | 0.0020 - 0.14 | 0.00020 - 0.063 | 0.000070 - 0.020 | 0.013 | 0.0073 | 0.016 | 1.3 | |
| Arsenic - dissolved | 298 / 441 | 68% | 0.000089 - 0.0027 | 0.000040 - 0.0013 | 0.000012 - 0.00063 | 0.00082 | 0.00069 | 0.00060 | 0.73 | |
| Barium - dissolved | 517 / 517 | 100% | 0.0011 - 0.013 | 0.000050 - 0.00075 | 0.0000090 - 0.00024 | 0.0049 | 0.0045 | 0.0023 | 0.46 | |
| Cadmium - dissolved | 64 / 573 | 11% | 0.0000030 - 0.000073 | 0.000020 - 0.00010 | 0.0000030 - 0.000037 | 0.000017 | 0.000015 | 0.000009 | 0.57 | |
| Chromium - dissolved | 316 / 416 | 76% | 0.000050 - 0.0011 | 0.00020 - 0.00050 | 0.000020 - 0.00025 | 0.00031 | 0.00026 | 0.00017 | 0.56 | |
| Copper - dissolved | 317 / 473 | 67% | 0.000030 - 0.0026 | 0.000060 - 0.00050 | 0.000020 - 0.00016 | 0.00047 | 0.00041 | 0.00038 | 0.80 | |
| Iron - dissolved | 547 / 587 | 93% | 0.0034 - 0.43 | 0.0080 - 0.050 | 0.00080 - 0.016 | 0.090 | 0.062 | 0.081 | 0.90 | |
| Lead - dissolved | 117 / 524 | 22% | 0.0000030 - 0.00037 | 0.000020 - 0.00050 | 0.0000030 - 0.00025 | 0.000057 | 0.000031 | 0.000049 | 0.86 | |
| Manganese - dissolved | 580 / 580 | 100% | 0.00025 - 0.15 | 0.000040 - 0.0025 | 0.0000060 - 0.0013 | 0.020 | 0.0084 | 0.028 | 1.4 | |
| Molybdenum - dissolved | 374 / 403 | 93% | 0.000015 - 0.00057 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00025 | 0.00028 | 0.000094 | 0.37 | |
| Nickel - dissolved | 285 / 436 | 65% | 0.000070 - 0.0038 | 0.000090 - 0.00062 | 0.000020 - 0.00016 | 0.00068 | 0.00050 | 0.00065 | 0.95 | |
| Selenium - dissolved | 10 / 445 | 2% | 0.000029 - 0.0010 | 0.000090 - 0.0025 | 0.000029 - 0.00078 | 0.00030 | 0.00031 | 0.000088 | 0.29 | |
| Silver - dissolved | 28 / 441 | 6% | 0.0000029 - 0.000044 | 0.000010 - 0.000050 | 0.0000029 - 0.000016 | 0.0000068 | 0.0000062 | 0.0000040 | 0.59 | |
| Zinc - dissolved | 247 / 488 | 51% | 0.00020 - 0.0084 | 0.00050 - 0.0038 | 0.000050 - 0.0012 | 0.0025 | 0.0023 | 0.0013 | 0.51 | |
| Cyanides (mg/L) | | | | | | | | | | |
| Cyanide | 28 / 433 | 6% | 0.00090 - 0.0081 | 0.0047 - 0.010 | 0.00090 - 0.0030 | 0.0022 | 0.0020 | 0.0011 | 0.51 | |
| Cyanide, Weak Acid Dissociable | 46 / 573 | 8% | 0.00090 - 0.021 | 0.0047 - 0.010 | 0.00090 - 0.0060 | 0.0022 | 0.0015 | 0.0015 | 0.67 | |
| Organic Compounds, (mg/L) | | | | | | | | | | |
| Dissolved Organic Carbon | 404 / 438 | 92% | 0.15 - 9.38 | 0.50 - 0.50 | 0.040 - 0.15 | 1.52 | 1.2 | 1.23 | 0.81 | |

Notes:

^a Frequency of detection (FOD) = Number of detected samples / total number of samples in data set.

^b When calculating the average, median, and standard deviation, non-detects with "U" or "UJ" qualifiers were included as the value of the RDL. Non-detect results of zero, without "U" or "UJ" qualifiers, were included as the value of the RDL.

Key:

NA = Not applicable

°C = degrees Celsius

MDL = method detection limit

MRL = method reporting limit

mg/L = milligram per liter

uS/cm = microSiemens per centimeter

mV = millivolt

NTU = nephelometric turbidity units

ORP = oxidation reduction potential

Table 9.1-12
Comparison of Human Health and Freshwater Aquatic Life Water Quality Criteria with Naturally Occurring Constituents in Surface Water
Upper Talarik Creek

| Analyte | Number of Samples | Chronic Aquatic Life Criteria | Number of Samples Exceeding Criteria ^a Drinking Water Standards |
|---|-------------------|-------------------------------|---|
| Field and Physical Parameters (mg/L, except where noted) | | | |
| pH (Field) | 777 | 161 | 52 |
| Dissolved Oxygen (Field) | 770 | 41 | 15 |
| Total Dissolved Solids | 674 | -- | 0 |
| Major Ions (mg/L) | | | |
| Alkalinity | 684 | 72 | 0 |
| Chloride | 527 | 0 | 0 |
| Fluoride | 527 | -- | 0 |
| Sulfate | 527 | -- | 0 |
| Nutrients (mg/L) | | | |
| Ammonia | 618 | 0 | -- |
| Nitrate + Nitrite | 518 | -- | 0 |
| Total Metals (mg/L) | | | |
| Aluminum | 674 | 152 | -- |
| Arsenic | 527 | -- | 1 |
| Barium | 611 | -- | 0 |
| Cadmium | 674 | 25 | 0 |
| Chromium | 527 | 0 | 0 |
| Copper | 674 | 55 | 0 |
| Iron | 674 | 8 | 204 |
| Lead | 674 | 47 | 0 |
| Manganese | 674 | -- | 103 |
| Mercury | 672 | 13 | 13 |
| Nickel | 674 | 0 | 0 |
| Selenium | 527 | 0 | 0 |
| Silver | 527 | 14 | -- |
| Zinc | 674 | 1 | -- |
| Dissolved Metals (mg/L) | | | |
| Aluminum | 669 | 8 | -- |
| Arsenic | 525 | -- | 0 |
| Barium | 599 | -- | 0 |
| Cadmium | 668 | 22 | 0 |
| Chromium | 492 | 0 | 0 |
| Copper | 534 | 24 | 0 |
| Iron | 669 | 0 | 15 |
| Lead | 609 | 19 | 0 |
| Manganese | 664 | -- | 0 |
| Nickel | 515 | 0 | 0 |
| Selenium | 527 | 0 | 0 |

| | | | |
|--------|-----|----|----|
| Silver | 523 | 13 | -- |
| Zinc | 552 | 1 | -- |

Cyanides (mg/L)

| | | | |
|-------------|-----|----|----|
| Cyanide WAD | 671 | 28 | 13 |
|-------------|-----|----|----|

Notes:

^a Surface water sample results were compared to criteria from ADEC (2008 and 2009). Drinking water standards were compared to total metals data. Chronic aquatic life criteria were compared to both total and dissolved metals data. Hardness-dependent criteria are based on preliminary estimates.

Key:

-- = Not applicable

mg/L = milligrams per liter

WAD = weak acid dissociable

References:

Alaska Department of Environmental Conservation (ADEC). 2008. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. As amended through December 12, 2008.
ADEC. 2009. 18 AAC 70. Water Quality Standards. Amended as of September 19, 2009.

Table 9.1-13
Upstream to Downstream Sample Location Ranks for Spatial Analyses
Upper Talarik Creek

| Location ^a | Rank ^b |
|-----------------------|-------------------|
| UT100E | 1 |
| UT100D1 | 2 |
| UT100D | 3 |
| UT100C2 ^c | 4 |
| UT100C1 ^c | 5 |
| UT100C | 6 |
| UT100B | 7 |
| UT100APC1 | 8 |
| UT100APC2 | 9 |
| UT100APC3 | 10 |

Notes:

^a Only main stem sample locations were included in the upstream to downstream ranking and analyses.

^b Ranks begin with most upstream location (1= most upstream, 11= most downstream).

^c Samples were only tested for field parameters from 2009 - 2012.

Table 9.1-14
Results of Spatial Regression Analysis of Results for Naturally Occurring Constituents in Surface Water
Upper Talarik Creek

| Analyte | tau | p-Value | S | D | VarS | Spatial Trend | ts.intercept | ts.slope | R ² Value | Regression Significantly Different? |
|---|---------|----------|--------|--------|----------|---------------|--------------|----------|----------------------|-------------------------------------|
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | | | |
| Total Dissolved Solids | -0.35 | 2.49E-23 | -27900 | 79700 | 7860000 | Decreasing | 64.9 | -2.7 | 0.1225 | YES |
| pH (Field, Standard Units) | -0.0154 | 0.62 | -1950 | 127000 | 15400000 | Stable | 6.91 | -0.00333 | 0.00023716 | NO |
| Dissolved Oxygen | 0.00816 | 0.793 | 1020 | 125000 | 15200000 | Stable | 9.39 | 0.035 | 0.0000666 | NO |
| Water Temperature (°C) | -0.0161 | 0.604 | -2060 | 128000 | 15700000 | Stable | 2.1 | -0.0225 | 0.00025921 | NO |
| Specific Conductivity (Field, uS/cm) | -0.0154 | 0.62 | -1950 | 127000 | 15400000 | Stable | 6.91 | -0.00333 | 0.00023716 | NO |
| Turbidity (NTU) | -0.0174 | 0.625 | -1310 | 75200 | 7150000 | Stable | 1.08 | -0.03 | 0.00030276 | NO |
| Total Suspended Solids | 0.439 | 0 | 33700 | 76800 | 7560000 | Increasing | 0.181 | 0.446 | 0.192721 | YES |
| ORP (mV) | 0.0466 | 0.14 | 5430 | 116000 | 13500000 | Stable | 102 | 1.75 | 0.00217156 | NO |
| Major Ions (mg/L) | | | | | | | | | | |
| Calcium - total | -0.382 | 3.27E-21 | -17300 | 45200 | 3350000 | Decreasing | 11300 | -318 | 0.145924 | YES |
| Magnesium - total | -0.661 | 0 | -29700 | 44900 | 3320000 | Decreasing | 3180 | -185 | 0.436921 | YES |
| Sodium - total | -0.488 | 0 | -21900 | 44900 | 3320000 | Decreasing | 3470 | -123 | 0.238144 | YES |
| Potassium - total | -0.532 | 0 | -23800 | 44600 | 3290000 | Decreasing | 519 | -19.1 | 0.283024 | YES |
| Alkalinity, Total | -0.449 | 0 | -37500 | 83400 | 8380000 | Decreasing | 44.2 | -1.67 | 0.201601 | YES |
| Sulfate | -0.45 | 0 | -20400 | 45200 | 3350000 | Decreasing | 5.34 | -0.327 | 0.2025 | YES |
| Chloride | 0.165 | 5.14E-05 | 7400 | 44800 | 3340000 | Increasing | 0.605 | 0.0108 | 0.027225 | YES |
| Fluoride | 0.291 | 2.64E-12 | -12300 | 42200 | 3090000 | Decreasing | 0.0424 | -0.0015 | 0.084681 | YES |
| Hardness as CaCO ₃ | -0.481 | 0 | -38700 | 80500 | 7920000 | Decreasing | 42.9 | -1.8 | 0.231361 | YES |
| Nutrients, (mg/L) | | | | | | | | | | |
| Nitrogen, Nitrate-Nitrite | -0.215 | 1.44E-07 | -9350 | 43400 | 3160000 | Decreasing | 0.246 | -0.00964 | 0.046225 | YES |
| Total Metals (mg/L) | | | | | | | | | | |
| Aluminum | 0.115 | 0.00112 | 8970 | 78300 | 7580000 | Increasing | 31.9 | 0.9 | 0.013225 | YES |
| Arsenic | 0.452 | 0 | 19900 | 44000 | 3310000 | Increasing | 0.175 | 0.118 | 0.204304 | YES |
| Barium | -0.41 | 0 | -26300 | 64100 | 5620000 | Decreasing | 6.47 | -0.225 | 0.1681 | YES |
| Chromium | 0.101 | 0.0128 | 4560 | 45000 | 3350000 | Increasing | 0.261 | 0.00558 | 0.010201 | YES |
| Copper | -0.188 | 1.29E-07 | -14800 | 78500 | 7830000 | Decreasing | 0.52 | -0.0177 | 0.035344 | YES |
| Iron | -0.0475 | 0.175 | -3790 | 79800 | 7800000 | Stable | 257 | -12.8 | 0.00225625 | NO |
| Manganese | -0.0473 | 0.177 | -3760 | 79400 | 7750000 | Stable | 22.9 | -1.15 | 0.00223729 | NO |
| Molybdenum | 0.418 | 0 | 17600 | 42300 | 3040000 | Increasing | 0.171 | 0.017 | 0.174724 | YES |
| Nickel | -0.224 | 5.15E-10 | -16500 | 73700 | 7060000 | Decreasing | 0.515 | -0.022 | 0.050176 | YES |
| Zinc | -0.0891 | 0.0147 | -6720 | 75500 | 7590000 | Decreasing | 2.43 | -0.0169 | 0.00793881 | YES |

^aDifferences are considered statistically significant if the p-value is less than 0.050.

Linear regression analysis was conducted using results from each main stem sample location.

Decreasing - analyte concentration is decreasing with downstream distance.

Increasing - analyte concentration is increasing with downstream distance.

Stable - analyte concentration is stable with downstream distance.

Table 9.1-15
Surface Water Data Summary for Naturally Occurring Constituents
Kaskanak Creek

| Analyte | cy of Detection | Percent Detected | Range of Detects (Min-Max) | Limits (MRL) | (MDL) (Min-Max) | Mean ^b | Median ^b | Standard Deviation ^b | Coefficient of Variation |
|---|-----------------|------------------|----------------------------|---------------------|----------------------|-------------------|---------------------|---------------------------------|--------------------------|
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | | |
| Total Dissolved Solids | 50 / 50 | 100% | 21.3 - 58.8 | 10 - 10 | 3.10 - 3.10 | 40.9 | 40.6 | 8.41 | 0.21 |
| pH (Field, Standard Units) | 51 / 51 | 100% | 4.30 - 8.24 | NA - NA | NA - NA | 6.58 | 6.55 | 0.60 | 0.09 |
| Dissolved Oxygen | 49 / 49 | 100% | 1.65 - 16.1 | NA - NA | NA - NA | 10.1 | 10.1 | 2.32 | 0.23 |
| Water Temperature (°C) | 51 / 51 | 100% | -0.14 - 12.2 | NA - NA | NA - NA | 4.30 | 3.19 | 4.17 | 0.97 |
| Specific Conductivity (Field, uS/cm) | 51 / 51 | 100% | 0.00 - 68 | NA - NA | NA - NA | 47.1 | 49 | 12.2 | 0.26 |
| Turbidity (NTU) | 49 / 49 | 100% | 0.69 - 22.2 | NA - NA | NA - NA | 2.61 | 1.42 | 3.62 | 1.39 |
| Total Suspended Solids | 50 / 50 | 100% | 0.60 - 34 | 0.50 - 2.94 | 0.15 - 0.88 | 3.95 | 2.94 | 5.12 | 1.30 |
| ORP (mV) | 49 / 49 | 100% | -162 - 282 | NA - NA | NA - NA | 95.5 | 106 | 91.8 | 0.96 |
| Major Ions (mg/L) | | | | | | | | | |
| Calcium - dissolved | 41 / 41 | 100% | 2.65 - 7.29 | 0.050 - 0.23 | 0.015000 - 0.0748 | 5.35 | 5.54 | 1.07 | 0.20 |
| Calcium - total | 42 / 42 | 100% | 2.72 - 7.23 | 0.050 - 0.20 | 0.015 - 0.0647 | 5.38 | 5.48 | 1.01 | 0.19 |
| Magnesium - dissolved | 41 / 41 | 100% | 0.84 - 1.84 | 0.0050 - 0.21 | 0.001550 - 0.06700 | 1.37 | 1.38 | 0.26 | 0.19 |
| Magnesium - total | 42 / 42 | 100% | 0.83 - 1.87 | 0.0050 - 0.18 | 0.00155 - 0.058 | 1.38 | 1.44 | 0.25 | 0.18 |
| Sodium - dissolved | 41 / 41 | 100% | 1.65 - 3.35 | 0.070 - 0.18 | 0.022 - 0.058 | 2.61 | 2.70 | 0.42 | 0.16 |
| Sodium - total | 42 / 42 | 100% | 1.62 - 3.45 | 0.10 - 0.16 | 0.031 - 0.05 | 2.62 | 2.70 | 0.41 | 0.16 |
| Potassium - dissolved | 40 / 40 | 100% | 0.30 - 0.84 | 0.0040 - 0.050 | 0.001420 - 0.0155 | 0.48 | 0.47 | 0.099 | 0.21 |
| Potassium - total | 42 / 42 | 100% | 0.32 - 0.94 | 0.0040 - 0.050 | 0.001420 - 0.0155 | 0.48 | 0.48 | 0.11 | 0.23 |
| Alkalinity, Total | 52 / 53 | 98% | 6.20 - 35.9 | 10.0 - 40.0 | 3.10 - 12.40 | 23.1 | 24 | 5.72 | 0.25 |
| Sulfate | 42 / 42 | 100% | 0.70 - 2.43 | 0.10 - 0.10 | 0.031 - 0.031 | 1.55 | 1.55 | 0.41 | 0.26 |
| Chloride | 42 / 42 | 100% | 0.68 - 1.37 | 0.10 - 0.10 | 0.031 - 0.031 | 0.99 | 0.97 | 0.16 | 0.16 |
| Fluoride | 32 / 42 | 76% | 0.031 - 0.11 | 0.10 - 0.10 | 0.031 - 0.031 | 0.045 | 0.039 | 0.018 | 0.41 |
| Hardness as CaCO ₃ | 51 / 51 | 100% | 10.2 - 25.5 | 0.50 - 1.25 | 0.356 - 1.00 | 19 | 19.7 | 3.55 | 0.19 |
| Nutrients, (mg/L) | | | | | | | | | |
| Total Ammonia - N | 11 / 43 | 26% | 0.031 - 0.17 | 0.10 - 0.10 | 0.031 - 0.031 | 0.056 | 0.031 | 0.035 | 0.63 |
| Nitrate-Nitrite | 33 / 39 | 85% | 0.031 - 1.3 | 0.10 - 1 | 0.031 - 0.31 | 0.22 | 0.11 | 0.29 | 1.35 |
| Total Phosphorous | 37 / 42 | 88% | 0.0031 - 0.13 | 0.007 - 0.10 | 0.0022 - 0.031 | 0.042 | 0.036 | 0.024 | 0.56 |
| Total Orthophosphate (as P) | 0 / 5 | 0% | NA - NA | 0.10 - 0.10 | 0.031 - 0.031 | NA | NA | NA | NA |
| Total Metals (mg/L) | | | | | | | | | |
| Aluminum - total | 49 / 50 | 98% | 0.011 - 0.39 | 0.00020 - 0.025 | 0.00007 - 0.0078 | 0.060 | 0.045 | 0.060 | 0.99 |
| Arsenic - total | 41 / 41 | 100% | 0.00094 - 0.0027 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.0016 | 0.0015 | 0.00041 | 0.25 |
| Barium - total | 41 / 41 | 100% | 0.0011 - 0.0032 | 0.000050 - 0.00030 | 0.000025 - 0.000094 | 0.0018 | 0.0017 | 0.00037 | 0.20 |
| Cadmium - total | 4 / 50 | 8% | 0.000006 - 0.000037 | 0.000020 - 0.00010 | 0.0000062 - 0.000037 | 0.000020 | 0.000015 | 0.0000085 | 0.42 |
| Chromium - total | 34 / 41 | 83% | 0.000071 - 0.0011 | 0.00020 - 0.00020 | 0.000062 - 0.00010 | 0.00038 | 0.00036 | 0.00018 | 0.47 |
| Copper - total | 43 / 51 | 84% | 0.00013 - 0.0012 | 0.000060 - 0.00050 | 0.000021 - 0.000062 | 0.00035 | 0.00028 | 0.00021 | 0.60 |
| Iron - total | 50 / 50 | 100% | 0.21 - 1.53 | 0.0080 - 0.020 | 0.0027 - 0.0062 | 0.52 | 0.49 | 0.21 | 0.41 |
| Lead - total | 15 / 50 | 30% | 0.000031 - 0.0010 | 0.000050 - 0.0020 | 0.000022 - 0.00010 | 0.00012 | 0.0001 | 0.00017 | 1.43 |
| Manganese - total | 50 / 50 | 100% | 0.0077 - 0.039 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.015 | 0.014 | 0.0047 | 0.32 |
| Molybdenum - total | 42 / 42 | 100% | 0.00013 - 0.00060 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00036 | 0.00038 | 0.00010 | 0.28 |
| Nickel - total | 30 / 51 | 59% | 0.000089 - 0.00062 | 0.000090 - 0.00062 | 0.000030 - 0.000062 | 0.00029 | 0.00021 | 0.00016 | 0.55 |
| Selenium - total | 2 / 42 | 5% | 0.000029 - 0.00031 | 0.000090 - 0.0010 | 0.000029 - 0.00031 | 0.00028 | 0.00031 | 0.000077 | 0.28 |
| Silver - total | 0 / 41 | 0% | 0.000029 - 0.000062 | 0.000010 - 0.000020 | 0.0000029 - 0.000062 | 0.000060 | 0.000062 | 0.0000073 | 0.12 |
| Zinc - total | 29 / 50 | 58% | 0.00047 - 0.0080 | 0.00050 - 0.0031 | 0.00026 - 0.00047 | 0.0022 | 0.0016 | 0.0015 | 0.67 |

| Dissolved Metals (mg/L) | | | | | | | | | |
|----------------------------------|---------|------|----------------------|---------------------|-----------------------|-----------|----------|-----------|------|
| Aluminum - dissolved | 46 / 50 | 92% | 0.0059 - 0.071 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.021 | 0.017 | 0.014 | 0.68 |
| Arsenic - dissolved | 40 / 41 | 98% | 0.0003 - 0.0019 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.0011 | 0.0011 | 0.00031 | 0.28 |
| Barium - dissolved | 37 / 37 | 100% | 0.0012 - 0.0024 | 0.000050 - 0.00030 | 0.000025 - 0.000094 | 0.0017 | 0.0016 | 0.00030 | 0.18 |
| Cadmium - dissolved | 2 / 51 | 3.9% | 0.0000062 - 0.000039 | 0.000020 - 0.00010 | 0.000062 - 0.000037 | 0.000021 | 0.000015 | 0.0000085 | 0.42 |
| Chromium - dissolved | 33 / 36 | 92% | 0.00010 - 0.00065 | 0.00020 - 0.00020 | 0.00062 - 0.00010 | 0.00033 | 0.00033 | 0.00013 | 0.39 |
| Copper - dissolved | 23 / 24 | 96% | 0.00017 - 0.00043 | 0.000060 - 0.00020 | 0.000021 - 0.000062 | 0.00026 | 0.00024 | 0.000068 | 0.26 |
| Iron - dissolved | 50 / 50 | 100% | 0.099 - 0.56 | 0.0080 - 0.020 | 0.0027 - 0.0062 | 0.24 | 0.25 | 0.085 | 0.35 |
| Lead - dissolved | 11 / 42 | 26% | 0.000031 - 0.00026 | 0.000050 - 0.00020 | 0.000022 - 0.00010 | 0.000082 | 0.0001 | 0.000052 | 0.63 |
| Manganese - dissolved | 50 / 50 | 100% | 0.0070 - 0.021 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.013 | 0.013 | 0.0030 | 0.24 |
| Molybdenum - dissolved | 39 / 39 | 100% | 0.00010 - 0.00058 | 0.000020 - 0.0010 | 0.000062 - 0.00031 | 0.00036 | 0.00038 | 0.00011 | 0.31 |
| Nickel - dissolved | 24 / 34 | 71% | 0.000090 - 0.00062 | 0.000090 - 0.00062 | 0.000030 - 0.000062 | 0.00037 | 0.00032 | 0.00017 | 0.45 |
| Selenium - dissolved | 1 / 42 | 2.4% | 0.000029 - 0.00031 | 0.000090 - 0.0010 | 0.000029 - 0.00031 | 0.00028 | 0.00031 | 0.000077 | 0.28 |
| Silver - dissolved | 2 / 41 | 4.9% | 0.0000029 - 0.000014 | 0.000010 - 0.000020 | 0.0000029 - 0.0000062 | 0.0000064 | 0.000006 | 0.0000014 | 0.22 |
| Zinc - dissolved | 20 / 33 | 61% | 0.0010 - 0.0049 | 0.00050 - 0.0031 | 0.00026 - 0.00047 | 0.0023 | 0.0019 | 0.0010 | 0.44 |
| Cyanides (mg/L) | | | | | | | | | |
| Cyanide, Total | 4 / 42 | 10% | 0.0015 - 0.0050 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0024 | 0.0023 | 0.0011 | 0.48 |
| Cyanide, Weak Acid Dissociable | 5 / 50 | 10% | 0.0015 - 0.0050 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0022 | 0.0015 | 0.0011 | 0.48 |
| Organic Compounds, (mg/L) | | | | | | | | | |
| Dissolved Organic Carbon | 23 / 23 | 100% | 0.41 - 5.36 | 0.50 - 0.50 | 0.15 - 0.15 | 2.03 | 1.79 | 1.03 | 0.51 |

Notes:

^a Frequency of detection (FOD) = Number of detected samples / total number of samples in data set.

^b When calculating the average, median, and standard deviation, non-detects with "U" or "UJ" qualifiers were included as the value of the RDL. Non-detect results of zero, without "U" or "UJ" qualifiers, were included as the value of the RDL.

Key:

NA = Not applicable

°C = degrees Celsius

MDL = method detection limit

MRL = method reporting limit

mg/L = milligram per liter

uS/cm = microSiemens per centimeter

mV = millivolt

NTU = nephelometric turbidity units

ORP = oxidation reduction potential

Table 9.1-16

Comparison of Human Health and Freshwater Aquatic Life Water Quality Criteria with Naturally Occurring Constituent Concentrations in Surface Water
Kaskanak Creek

| Analyte | Number of Samples | Number of Samples Exceeding Criteria ^a | |
|---|-------------------|---|--------------------------|
| | | Chronic Aquatic Life Criteria | Drinking Water Standards |
| Field and Physical Parameters (mg/L, except where noted) | | | |
| Total Dissolved Solids | 51 | -- | 0 |
| pH (Field) | 51 | 22 | 8 |
| Dissolved Oxygen (Field) | 49 | 2 | 1 |
| Major Ions (mg/L) | | | |
| Alkalinity | 53 | 10 | -- |
| Sulfate | 42 | -- | 0 |
| Chloride | 42 | 0 | 0 |
| Fluoride | 42 | -- | 0 |
| Nutrients (mg/L) | | | |
| Ammonia | 43 | 0 | -- |
| Nitrate + Nitrite | 40 | -- | 0 |
| Total Metals (mg/L) | | | |
| Aluminum | 51 | 8 | -- |
| Arsenic | 42 | -- | 0 |
| Barium | 42 | -- | 0 |
| Cadmium | 51 | 0 | 0 |
| Chromium | 42 | 0 | 0 |
| Copper | 51 | 0 | 0 |
| Iron | 51 | 2 | 47 |
| Lead | 51 | 5 | 0 |
| Manganese | 51 | -- | 1 |
| Mercury | 50 | 0 | 0 |
| Nickel | 51 | 0 | -- |
| Selenium | 42 | 0 | 0 |
| Silver | 42 | 0 | -- |
| Zinc | 51 | 0 | -- |
| Dissolved Metals (mg/L) | | | |
| Aluminum | 50 | 0 | -- |
| Arsenic | 41 | -- | 0 |
| Barium | 37 | -- | 0 |
| Cadmium | 51 | 0 | 0 |
| Chromium | 36 | 0 | 0 |
| Copper | 35 | 0 | 0 |
| Iron | 50 | 0 | 8 |
| Lead | 42 | 1 | 0 |
| Manganese | 50 | -- | 0 |
| Nickel | 34 | 0 | -- |
| Selenium | 42 | 0 | 0 |
| Silver | 41 | 0 | -- |
| Zinc | 34 | 0 | -- |

16%

2%

| Cyanides (mg/L) | | | |
|-----------------|----|---|---|
| Cyanide WAD | 51 | 1 | 0 |

Notes:

^a Surface water sample results were compared to criteria from ADEC (2008 and 2009). Drinking water standards were compared to total metals data. Chronic aquatic life criteria were compared to both total and dissolved metals data. Hardness-dependent criteria are based on preliminary estimates.

Key:

-- = Not applicable

mg/L = milligrams per liter

WAD = weak acid dissociable

References:

Alaska Department of Environmental Conservation (ADEC). 2008. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. As amended through December 12, 2008.

ADEC. 2009. 18 AAC 70. Water Quality Standards. Amended as of September 19, 2009.

Table 9.1-17
Surface Water Data Summary for Naturally Occurring Constituents
Koktuli River

| Analyte | Frequency of | Percent Detected | Range of Detects (Min-Max) | Range of Reporting Limits | Range of Detection Limits (MDL) | Mean ^b | Median ^b | Standard Deviation ^b | Coefficient of Variation |
|---|--------------|------------------|----------------------------|---------------------------|---------------------------------|-------------------|---------------------|---------------------------------|--------------------------|
| Field and Physical parameters (mg/L, except where noted) | | | | | | | | | |
| Total Dissolved Solids | 104 / 106 | 98% | 3.1 - 52 | 10 - 10 | 3.1 - 3.1 | 33 | 32.5 | 9.38 | 0.28 |
| pH (Field, Standard Units) | 108 / 108 | 100% | 4.78 - 7.65 | NA - NA | NA - NA | 6.32 | 6.42 | 0.64 | 0.10 |
| Dissolved Oxygen | 105 / 105 | 100% | 5.06 - 15.2 | NA - NA | NA - NA | 9.82 | 9.83 | 2.06 | 0.21 |
| Water Temperature (°C) | 108 / 108 | 100% | -0.07 - 12.8 | NA - NA | NA - NA | 3.95 | 1.86 | 4.04 | 1.02 |
| Specific Conductivity (Field, uS/cm) | 105 / 105 | 100% | 24 - 62 | NA - NA | NA - NA | 42.7 | 44 | 6.94 | 0.16 |
| Turbidity (NTU) | 100 / 100 | 100% | 0.20 - 3.28 | NA - NA | NA - NA | 0.95 | 0.75 | 0.69 | 0.72 |
| Total Suspended Solids | 94 / 104 | 90% | 0.15 - 9.57 | 0.50 - 2 | 0.15 - 0.60 | 1.70 | 1.17 | 1.67 | 0.98 |
| ORP (mV) | 106 / 106 | 100% | -174 - 310 | NA - NA | NA - NA | 148 | 154 | 71.6 | 0.48 |
| Major Ions (mg/L) | | | | | | | | | |
| Calcium - dissolved | 76 / 76 | 100% | 2.37 - 5.96 | 0.050 - 0.17 | 0.015 - 0.054 | 4.49 | 4.67 | 0.81 | 0.18 |
| Calcium - total | 78 / 78 | 100% | 2.30 - 6.05 | 0.050 - 0.21 | 0.015 - 0.066 | 4.52 | 4.71 | 0.78 | 0.17 |
| Magnesium - dissolved | 76 / 76 | 100% | 0.62 - 1.75 | 0.0050 - 0.15 | 0.0016 - 0.048 | 1.20 | 1.20 | 0.25 | 0.21 |
| Magnesium - total | 78 / 78 | 100% | 0.63 - 1.77 | 0.0050 - 0.18 | 0.0016 - 0.059 | 1.21 | 1.18 | 0.26 | 0.22 |
| Sodium - dissolved | 77 / 77 | 100% | 1.56 - 3.47 | 0.10 - 0.13 | 0.031 - 0.041 | 2.55 | 2.53 | 0.42 | 0.17 |
| Sodium - total | 78 / 78 | 100% | 1.49 - 3.62 | 0.10 - 0.16 | 0.031 - 0.051 | 2.54 | 2.49 | 0.44 | 0.17 |
| Potassium - dissolved | 74 / 74 | 100% | 0.23 - 0.63 | 0.004 - 0.050 | 0.0014 - 0.016 | 0.40 | 0.39 | 0.075 | 0.19 |
| Potassium - total | 76 / 76 | 100% | 0.25 - 0.65 | 0.004 - 0.050 | 0.0014 - 0.016 | 0.39 | 0.38 | 0.078 | 0.20 |
| Alkalinity, Total | 106 / 106 | 100% | 7.16 - 37.8 | 10 - 40 | 3.10 - 12.4 | 19.1 | 18.7 | 6.04 | 0.32 |
| Sulfate | 78 / 78 | 100% | 0.81 - 3.42 | 0.10 - 0.10 | 0.031 - 0.031 | 1.96 | 1.88 | 0.73 | 0.37 |
| Chloride | 77 / 77 | 100% | 0.41 - 1.25 | 0.10 - 0.10 | 0.031 - 0.031 | 0.78 | 0.761 | 0.17 | 0.21 |
| Fluoride | 56 / 78 | 72% | 0.031 - 0.16 | 0.10 - 0.10 | 0.031 - 0.031 | 0.070 | 0.051 | 0.040 | 0.58 |
| Hardness as CaCO ₃ | 106 / 106 | 100% | 8.34 - 22.4 | 0.50 - 1.26 | 0.41 - 1 | 16.1 | 16.6 | 2.78 | 0.17 |
| Nutrients, (mg/L) | | | | | | | | | |
| Total Ammonia - N | 9 / 95 | 9% | 0.031 - 0.13 | 0.10 - 0.10 | 0.031 - 0.031 | 0.039 | 0.031 | 0.022 | 0.56 |
| Nitrate-Nitrite | 54 / 76 | 71% | 0.031 - 0.94 | 0.10 - 2 | 0.031 - 0.62 | 0.14 | 0.10 | 0.16 | 1.18 |
| Total Phosphorous | 59 / 77 | 77% | 0.0031 - 0.063 | 0.0070 - 0.10 | 0.0022 - 0.031 | 0.014 | 0.011 | 0.012 | 0.83 |
| Total Orthophosphate (as P) | 0 / 7 | 0% | 0.031 - 0.10 | 0.10 - 0.10 | 0.031 - 0.031 | 0.070 | 0.10 | 0.037 | 0.52 |
| Total Metals (mg/L) | | | | | | | | | |
| Aluminum - total | 99 / 103 | 96% | 0.0055 - 0.16 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.041 | 0.028 | 0.034 | 0.85 |
| Arsenic - total | 44 / 78 | 56% | 0.00015 - 0.0017 | 0.000040 - 0.00050 | 0.000012 - 0.00031 | 0.00047 | 0.00033 | 0.00028 | 0.60 |
| Barium - total | 97 / 97 | 100% | 0.0022 - 0.0095 | 0.000050 - 0.00030 | 0.000025 - 0.000094 | 0.0041 | 0.0032 | 0.0018 | 0.44 |
| Cadmium - total | 7 / 104 | 6.7% | 0.000015 - 0.000071 | 0.000020 - 0.00010 | 0.0000062 - 0.000037 | 0.000019 | 0.000015 | 0.0000091 | 0.49 |
| Chromium - total | 56 / 76 | 74% | 0.000062 - 0.00068 | 0.000020 - 0.00020 | 0.000062 - 0.00010 | 0.00025 | 0.00023 | 0.00011 | 0.43 |
| Copper - total | 57 / 104 | 55% | 0.00022 - 0.0016 | 0.000060 - 0.00050 | 0.000021 - 0.000062 | 0.00050 | 0.00050 | 0.00018 | 0.36 |
| Iron - total | 103 / 103 | 100% | 0.023 - 0.43 | 0.0080 - 0.020 | 0.0027 - 0.0062 | 0.15 | 0.13 | 0.091 | 0.60 |
| Lead - total | 33 / 103 | 32% | 0.000031 - 0.0028 | 0.000050 - 0.00020 | 0.000022 - 0.00010 | 0.00011 | 0.000031 | 0.00031 | 2.89 |
| Manganese - total | 105 / 105 | 100% | 0.0033 - 0.15 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.024 | 0.011 | 0.028 | 1.18 |
| Molybdenum - total | 70 / 75 | 93% | 0.000015 - 0.00039 | 0.000020 - 0.0010 | 0.0000062 - 0.00031 | 0.00022 | 0.00024 | 0.000071 | 0.32 |
| Nickel - total | 51 / 85 | 60% | 0.000062 - 0.00064 | 0.000090 - 0.00062 | 0.000030 - 0.00062 | 0.00027 | 0.00020 | 0.00016 | 0.59 |
| Selenium - total | 1 / 78 | 1.3% | 0.00012 - 0.00031 | 0.000090 - 0.0010 | 0.000029 - 0.00031 | 0.00030 | 0.00031 | 0.000044 | 0.15 |
| Silver - total | 8 / 78 | 10% | 0.0000036 - 0.000019 | 0.000010 - 0.000020 | 0.0000029 - 0.0000062 | 0.0000069 | 0.0000062 | 0.0000026 | 0.38 |
| Zinc - total | 50 / 103 | 49% | 0.00047 - 0.029 | 0.00050 - 0.0031 | 0.00026 - 0.00047 | 0.0035 | 0.0031 | 0.0037 | 1.07 |

| Dissolved Metals (mg/L) | | | | | | | | | | |
|----------------------------------|-----------|------|----------------------|---------------------|----------------------|----------|----------|-----------|------|--|
| Aluminum - dissolved | 100 / 106 | 94% | 0.0022 - 0.062 | 0.00020 - 0.025 | 0.000070 - 0.0078 | 0.015 | 0.010 | 0.013 | 0.86 | |
| Arsenic - dissolved | 39 / 78 | 50% | 0.00015 - 0.0012 | 0.000040 - 0.0005 | 0.000012 - 0.00031 | 0.00039 | 0.00031 | 0.00018 | 0.47 | |
| Barium - dissolved | 92 / 92 | 100% | 0.0013 - 0.0095 | 0.000050 - 0.0003 | 0.000025 - 0.000094 | 0.0039 | 0.0033 | 0.0017 | 0.44 | |
| Cadmium - dissolved | 7 / 105 | 6.7% | 0.0000062 - 0.000037 | 0.000020 - 0.0001 | 0.0000062 - 0.000037 | 0.000017 | 0.000015 | 0.0000061 | 0.35 | |
| Chromium - dissolved | 52 / 74 | 70% | 0.000062 - 0.00057 | 0.00020 - 0.0002 | 0.000062 - 0.00010 | 0.00025 | 0.00023 | 0.00011 | 0.44 | |
| Copper - dissolved | 56 / 71 | 79% | 0.00020 - 0.0011 | 0.000060 - 0.0005 | 0.000021 - 0.000062 | 0.00051 | 0.00050 | 0.00018 | 0.35 | |
| Iron - dissolved | 104 / 106 | 98% | 0.0066 - 0.26 | 0.0080 - 0.020 | 0.0027 - 0.0062 | 0.079 | 0.065 | 0.051 | 0.65 | |
| Lead - dissolved | 25 / 98 | 26% | 0.000031 - 0.00036 | 0.000050 - 0.0002 | 0.000022 - 0.00010 | 0.000063 | 0.000032 | 0.000052 | 0.83 | |
| Manganese - dissolved | 105 / 105 | 100% | 0.0023 - 0.14 | 0.000040 - 0.0010 | 0.000013 - 0.00050 | 0.019 | 0.0064 | 0.025 | 1.35 | |
| Molybdenum - dissolved | 67 / 72 | 93% | 0.000080 - 0.00035 | 0.000020 - 0.0010 | 0.000062 - 0.00031 | 0.00022 | 0.00022 | 0.000071 | 0.33 | |
| Nickel - dissolved | 34 / 68 | 50% | 0.000062 - 0.00065 | 0.000090 - 0.00062 | 0.000030 - 0.00062 | 0.00043 | 0.00041 | 0.00020 | 0.47 | |
| Selenium - dissolved | 2 / 78 | 2.6% | 0.000050 - 0.00036 | 0.000090 - 0.0010 | 0.000029 - 0.00031 | 0.00030 | 0.00031 | 0.000048 | 0.16 | |
| Silver - dissolved | 6 / 78 | 7.7% | 0.0000029 - 0.00003 | 0.000010 - 0.000020 | 0.000029 - 0.000062 | 0.000068 | 0.000062 | 0.000031 | 0.45 | |
| Zinc - dissolved | 48 / 83 | 58% | 0.0010 - 0.013 | 0.00050 - 0.0031 | 0.00026 - 0.00047 | 0.0031 | 0.0031 | 0.0017 | 0.54 | |
| Cyanides (mg/L) | | | | | | | | | | |
| Cyanide, Total | 5 / 77 | 6.5% | 0.0015 - 0.0050 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0021 | 0.0015 | 0.0011 | 0.53 | |
| Cyanide, Weak Acid Dissociable | 5 / 104 | 4.8% | 0.0015 - 0.0050 | 0.0050 - 0.0050 | 0.0015 - 0.0025 | 0.0018 | 0.0015 | 0.00073 | 0.41 | |
| Organic Compounds, (mg/L) | | | | | | | | | | |
| Dissolved Organic Carbon | 81 / 82 | 99% | 0.15 - 5.88 | 0.50 - 0.50 | 0.15 - 0.15 | 1.88 | 1.50 | 1.22 | 0.65 | |

Notes:

^a Frequency of detection (FOD) = Number of detected samples / total number of samples in data set.

^b When calculating the average, median, and standard deviation, non-detects with "U" or "UJ" qualifiers were included as the value of the RDL. Non-detect results of zero, without "U" or "UJ" qualifiers, were included as the value of the RDL.

Key:

NA = Not applicable

°C = degrees Celsius

MDL = method detection limit

MRL = method reporting limit

mg/L = milligram per liter

uS/cm = microSiemens per centimeter

mV = millivolt

NTU = nephelometric turbidity units

ORP = oxidation reduction potential

Table 9.1-18

**Comparison of Human Health and Freshwater Aquatic Life Water Quality Criteria with Naturally Occurring Constituents in Surface Water
Koktuli River**

| Analyte | Number of Samples | Chronic Aquatic Life Criteria | Number of Samples Exceeding Criteria ^a Drinking Water Standards |
|---|-------------------|-------------------------------|---|
| Field and Physical Parameters (mg/L, except where noted) | | | |
| Total Dissolved Solids | 106 | -- | 0 |
| pH (Field) | 108 | 59 | 32 |
| Dissolved Oxygen (Field) | 105 | 9 | 0 |
| Major Ions (mg/L) | | | |
| Alkalinity | 106 | 55 | -- |
| Chloride | 78 | 0 | 0 |
| Fluoride | 78 | -- | 0 |
| Sulfate | 78 | -- | 0 |
| Nutrients (mg/L) | | | |
| Ammonia | 98 | 0 | -- |
| Nitrate + Nitrite | 77 | -- | 0 |
| Total Metals (mg/L) | | | |
| Aluminum | 106 | 18 | -- |
| Arsenic | 78 | -- | 0 |
| Barium | 97 | -- | 0 |
| Cadmium | 106 | 3 | 0 |
| Chromium | 78 | 0 | 0 |
| Copper | 106 | 1 | 0 |
| Iron | 106 | 0 | 11 |
| Lead | 106 | 8 | 0 |
| Manganese | 106 | -- | 14 |
| Mercury | 104 | 0 | 0 |
| Nickel | 106 | 0 | 0 |
| Selenium | 78 | 0 | 0 |
| Silver | 78 | 0 | -- |
| Zinc | 106 | 3 | -- |
| Dissolved Metals (mg/L) | | | |
| Aluminum | 106 | 0 | -- |
| Arsenic | 78 | -- | 0 |
| Barium | 92 | -- | 0 |
| Cadmium | 106 | 1 | 0 |
| Chromium | 74 | 0 | 0 |
| Copper | 71 | 0 | 0 |
| Iron | 106 | 0 | 0 |
| Lead | 98 | 2 | 0 |
| Manganese | 105 | -- | 0 |
| Nickel | 68 | 0 | 0 |
| Selenium | 78 | 0 | 0 |
| Silver | 78 | 0 | -- |
| Zinc | 85 | 0 | -- |

| Cyanides (mg/L) | | | |
|-----------------|-----|---|---|
| Cyanide WAD(5) | 106 | 1 | 0 |

Notes:

^a Surface water sample results were compared to criteria from ADEC (2008 and 2009). Drinking water standards were compared to total metals data. Chronic aquatic life criteria were compared to both total and dissolved metals

Key:

-- = Not applicable

mg/L = milligrams per liter

WAD = weak acid dissociable

References:

Alaska Department of Environmental Conservation (ADEC). 2008. Alaska Water Quality Criteria Manual for Toxic and Other Deleterious Organic and Inorganic Substances. As amended through December 12, 2008.

ADEC. 2009. 18 AAC 70. Water Quality Standards. Amended as of September 19, 2009.